VOL. 6 NO. 12
June 30, 1981

Energy Research Abstracts

ABSTRACTS 16344-17906

Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications which are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following: programmatic efforts; legislative, regulatory, and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $3.00, foreign $3.75 per copy; annual cumulative index, domestic $4.00, foreign $5.00 per copy. The annual subscription price is $38.00 for domestic subscribers and $47.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. Indexes are cumulated semiannually and annually. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues including a semiannual index and an annual index is $184.00 for domestic subscribers and $230.00 for foreign subscribers. The semiannual and annual indexes will also be available separately to subscribers. The cost for the semiannual index is $18.00 (domestic) or $22.50 (foreign); the annual index is $33.00 (domestic) or $41.25 (foreign). A single issue costs $5.55 (domestic) or $6.95 (foreign).

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Energy Conservation Update (ECU)

A monthly abstract journal devoted to current information on energy conservation in buildings, transportation and propulsion, and industry; waste processing plants and equipment; energy storage; energy conversion; advanced automotive systems; combustion systems; power cycles; synthetic fuels; and power transmission. Available as PB81-914800.

Energy and the Environment (EAE)

A monthly abstract journal devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment. Available as PB81-914900.

Fossil Energy Update (FEU)

A monthly abstract journal devoted to information on the processing and use of fossil fuels. Available as PB81-914600.

Fusion Energy Update (CFU)

A monthly abstract journal devoted to information on controlled thermonuclear research. Available as PB81-915300.

Geothermal Energy Update (GEU)

A monthly abstract journal devoted to information on the exploration and development of geothermal resources. Available as PB81-914700.

Solar Energy Update (SEU)

A monthly abstract journal devoted to information on the utilization of solar, tidal, and wind energy. Available as PB81-914500.

Synthetic Fuels Update (SFU)

A monthly abstract journal devoted to information on coal gasification; coal liquefaction; other coal processing; biomass conversion to fuel; shale oil and tar sand bitumen production; hydrogen fuels; other hydrocarbon fuels; alcohol fuels; and inorganic hydrogen compound fuels. Available as PB81-902700.

INTERNATIONAL ENERGY PUBLICATIONS

Atomindex (Published in cooperation with the Technical Information Center by the International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria)

A semimonthly abstract journal devoted to information on nuclear science and technology. Through an exchange agreement, IAEA/INIS provides all non-U. S. nuclear information of *Atomindex* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. nuclear information to IAEA/INIS for inclusion in *Atomindex*. *Atomindex* is available by subscription from UNIPUB, P.O. Box 433, Murray Hill Station, New York, NY 10016. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $150.

Coal Abstracts (Published in cooperation with the Technical Information Center by the International Energy Agency, IEA Coal Research, London, England)

A monthly abstract journal devoted to information on coal. Through an exchange agreement, IEA Coal Research provides all non-U. S. coal information of *Coal Abstracts* to TIC for inclusion in the DOE/RECON Data Base; in turn, TIC provides all U. S. coal information to IEA Coal Research for inclusion in *Coal Abstracts*. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

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The Technical Information Center, as the national information center for the Department of Energy, manages, publishes, and disseminates scientific, technical, and practical energy information acquired from worldwide sources. It builds and maintains energy information data bases used to prepare abstracting journals, bibliographies, and literature searches. The data bases are also searchable via the Department's on-line retrieval system, DOE/RECON. This information is provided to DOE program offices and contractors; scientists; engineers; educational, commercial, and industrial communities; and the general public. The Technical Information Center conducts an active announcement and marketing program. It establishes policy and administers control of an inventory and registry for DOE publications. The Center also develops and evaluates new and effective information systems and services as required by scientific and technical management within the Department of Energy.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, conservation, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Federal, state, and municipal agencies concerned with energy development, conservation, and usage may obtain *ERA* free of charge. Inquiries should be directed to the Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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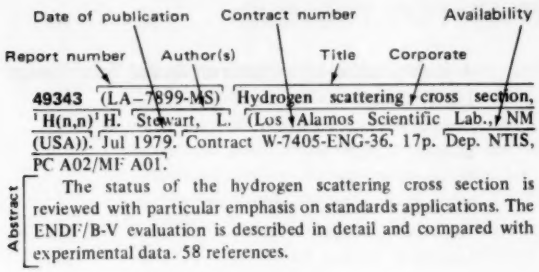
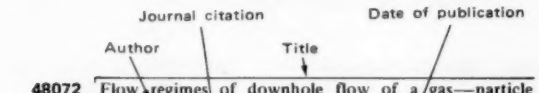
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



49343 (LA–7899-MS) Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

Abstract

The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.



48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). *J. Fluids Eng.*; 100: No. 4, 410-413 (Dec 1978).

Abstract

Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$. Stewart, L. **(Los Alamos Scientific Lab., NM (USA)).** Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles and informative phrases, or both, specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET
Neutron Reactions
Hydrogen scattering cross section, $^{1}H(n,n)^{1}H$ (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY
Research Programs
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, 96*th* Congress, 4:48749.

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience.

LA-7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-78-69	4:48158	Dep. NTIS, PC A03/MF A01

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Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts.* The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

01 COAL AND COAL PRODUCTS
- 04 Processing
- 05 By-Products
- 06 Properties
- 08 Waste Management
- 09 Environmental Aspects
- 10 Reserves and Exploration
- 20 Mining
- 30 Transport and Handling
- 40 Combustion
- 50 Marketing and Economics
- 60 Health and Safety
- 70 Regulations

02 PETROLEUM
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling and Production
- 04 Processing
- 05 Products and By-Products
- 06 Health and Safety
- 07 Marketing and Economics
- 08 Waste Management
- 09 Environmental Aspects
- 10 Policy, Legislation, and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Storage
- 50 Combustion

03 NATURAL GAS
- 01 Reserves
- 02 Geology and Exploration
- 03 Drilling, Production, and Processing
- 04 Products and By-Products
- 05 Health and Safety
- 06 Marketing and Economics
- 07 Waste Management
- 08 Environmental Effects
- 09 Artificial Stimulation, Plowshare, etc.
- 10 Policy, Legislation, and Regulation
- 20 Transport, Pipelines, and Handling
- 30 Properties
- 40 Combustion
- 50 Storage

04 OIL SHALES AND TAR SANDS
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 03 Drilling, Fracturing, and Mining
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 06 Direct Uses and By-Products
- 07 Health and Safety
- 08 Marketing and Economics
- 09 Waste Research and Management
- 10 Environmental Aspects
- 20 Regulations

05 NUCLEAR FUELS
- 01 Reserves
- 02 Exploration
- 03 Mining
- 04 Feed Processing
- 05 Enrichment
- 06 By-Products
- 07 Fuels Production and Properties
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 10 Marketing and Economics
- 20 Waste Management
- 30 Environmental Aspects
- 40 Health and Safety
- 50 Regulations

06 FUSION FUELS
- 01 Sources
- 02 Processing
- 03 By-Products
- 04 Transport and Storage
- 05 Health and Safety
- 06 Regulations and Policy
- 07 Waste Management
- 08 Properties
- 09 Environmental Aspects

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 01 Physical Isotope Separation
- 02 Radiation Sources
- 03 Isotopic Power Supplies

08 HYDROGEN
- 01 Production
- 02 Storage
- 03 Transport
- 04 Marketing and Economics
- 05 Safety
- 06 Industrial and Commercial Use
- 07 By-Products
- 08 Properties
- 09 Environmental Aspects

09 OTHER SYNTHETIC AND NATURAL FUELS
- 01 Hydrocarbon Fuels
- 02 Alcohol Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 04 Solid Waste Fuels
- 05 Liquid Waste Fuels
- 06 Gaseous Waste Fuels

13 HYDRO ENERGY
- 01 Resources and Availability
- 02 Site Geology and Meteorology
- 03 Plant Design and Operation
- 04 Regulations and Licensing
- 05 Economics and Management
- 06 Environmental Aspects
- 07 Power Conversion Systems

14 SOLAR ENERGY
- 01 Resources and Availability
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 05 Solar Energy Conversion
- 06 Photovoltaic Power Plants
- 07 Solar Thermal Power Plants
- 08 Ocean Thermal Gradient Power Plants
- 09 Solar Radiation Utilization
- 10 Solar Collectors and Concentrators
- 20 Heat Storage

15 GEOTHERMAL ENERGY
- 01 Resource Status and Assessment
- 02 Geology, Hydrology, and Geothermal Systems
- 03 Geothermal Exploration and Exploration Technology
- 04 Legal and Institutional Aspects

15 GEOTHERMAL ENERGY (CONT.)
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 07 By-Products
- 08 Geothermal Power Plants
- 09 Geothermal Engineering
- 10 Direct Energy Utilization
- 20 Geothermal Data and Theory

16 TIDAL POWER
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 07 Tidal Power Plants
- 08 Wave Energy Converters

17 WIND ENERGY
- 01 Availability (Climatology)
- 03 Regulations
- 04 Economics
- 05 Environmental Aspects
- 06 Wind Energy Engineering

20 ELECTRIC POWER ENGINEERING
- 01 Power Plants and Power Generation
- 02 Environmental Aspects
- 03 Power Transmission and Distribution

21 NUCLEAR POWER PLANTS
- 01 Power Reactors, Non-Breeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Non-Breeding, Light-Water Moderated, Non-Boiling Water Cooled
- 03 Power Reactors, Non-Breeding, Graphite Moderated
- 04 Power Reactors, Non-Breeding, Otherwise Moderated or Unmoderated
- 05 Power Reactors, Breeding
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 07 Regulation and Licensing
- 08 Economics
- 09 Process Heat Reactors

22 NUCLEAR REACTOR TECHNOLOGY
- 01 Theory and Calculation
- 02 Components and Accessories
- 03 Fuel Elements
- 04 Control Systems
- 05 Environmental Aspects
- 06 Research, Test, and Experimental Reactors
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety

25 ENERGY STORAGE
- 01 Magnetic
- 02 Compressed Gas
- 03 Pumped Hydro
- 04 Capacitor Banks
- 05 Flywheels
- 06 Thermal
- 07 Liquefied Gas
- 08 Chemical
- 09 Batteries

29 ENERGY PLANNING AND POLICY
- 01 Energy Analysis and Modeling
- 02 Economics and Sociology
- 03 Environment, Health, and Safety
- 04 Natural Resources
- 05 Research, Development, Demonstration, and Commercialization
- 06 Nuclear Energy
- 07 Transport and Storage
- 08 Waste Heat Utilization
- 10 Conservation
- 20 Supply, Demand, and Forecasting
- 30 Policy, Legislation, and Regulation
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 60 Electric Power
- 80 Consumption and Utilization
- 90 Unconventional Sources and Power Generation

30 ENERGY CONVERSION
- 01 MHD Generators
- 02 EHD Generators
- 03 Thermoelectric Generators
- 04 Thermionic Converters
- 05 Fuel Cells
- 08 Electromechanical Converters

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
- 01 Buildings
- 02 Transportation
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 09 Education and Public Relations

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
- 01 Internal Combustion Engines
- 02 External Combustion Engines
- 03 Electric-Powered Systems
- 04 Hybrid Systems
- 05 Flywheel Propulsion
- 06 Vehicle Design Factors
- 07 Emission Control
- 08 Alternative Fuels

36 MATERIALS
- 01 Metals and Alloys
- 02 Ceramics, Cermets, and Refractories
- 03 Composite Materials
- 04 Polymers and Plastics
- 06 Other Materials

40 CHEMISTRY
- 01 Analytical and Separations Chemistry
- 02 Inorganic and Physical Chemistry
- 03 Organic Chemistry
- 04 Electrochemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry
- 08 Combustion Chemistry

42 ENGINEERING
- 01 General Engineering
- 02 Facilities and Equipment
- 03 Lasers
- 04 Heat Transfer and Fluid Flow
- 05 Materials Testing

42 ENGINEERING (CONT.)
- 06 Safety Engineering
- 07 Vacuum Engineering
- 08 Electronic Circuits and Devices
- 09 Waste Processing Plants and Equipment
- 10 Combustion Systems
- 20 Underground Engineering
- 30 Marine Engineering
- 40 Pollution Control Equipment
- 50 Power Cycles

43 PARTICLE ACCELERATORS
- 01 Design, Development, and Operation
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 03 Auxiliaries and Components
- 04 Storage Rings

44 INSTRUMENTATION
- 01 Radiation Instrumentation
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 03 Miscellaneous Instruments
- 04 Well Logging Instrumentation

45 EXPLOSIONS AND EXPLOSIVES
- 01 Chemical
- 02 Nuclear
- 03 Explosion Detection

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

52 ENVIRONMENTAL SCIENCES, AQUATIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 04 Thermal Effluents Monitoring and Transport
- 05 Site Resource and Use Studies
- 06 Regulations

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES
- 01 Social and Economic Studies
- 02 Assessment of Energy Technologies
- 03 Environmental Impact Statements

55 BIOMEDICAL SCIENCES, BASIC STUDIES
01 Behavioral Biology
02 Biochemistry
03 Cytology
04 Genetics
05 Metabolism
06 Medicine
07 Microbiology
08 Morphology
09 Pathology
10 Physiological Systems
20 Public Health
30 Agriculture and Food Technology

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
01 Radiation Effects
02 Thermal Effects
03 Chemicals Metabolism and Toxicity
04 Other Environmental Pollutant Effects

57 HEALTH AND SAFETY

58 GEOSCIENCES
01 Geology and Hydrology
02 Geophysics
03 Mineralogy, Petrology, and Rock Mechanics
04 Geochemistry
05 Oceanography

64 PHYSICS RESEARCH
01 Astrophysics and Cosmology
02 Atmospheric Physics
03 Atomic, Molecular, and Chemical Physics
04 Fluid Physics
50 High Energy Physics

65 PHYSICS RESEARCH (CONT.)
10 Nuclear Physics
40 Radiation and Shielding Physics
50 Medical Physics
60 Solid State Physics
70 Theoretical Physics
80 Mathematical Physics

65 PHYSICS RESEARCH (CONT.)
90 Communication, Education, History, and Philosophy

70 FUSION ENERGY
01 Plasma Research
02 Fusion Power Plant Technology

99 GENERAL AND MISCELLANEOUS
01 Management
02 Mathematics and Computers
03 Information Handling
04 Law
05 Civilian Defense

CORPORATE INDEX

AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

SUBJECT CONTENTS (ALPHABETICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 294 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope notes is available as DOE/TIC-4584-R4 from NTIS for $7.00.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS
- 08 Alternative Fuels
- 03 Electric-Powered Systems
- 07 Emission Control
- 02 External Combustion Engines
- 05 Flywheel Propulsion
- 04 Hybrid Systems
- 01 Internal Combustion Engines
- 06 Vehicle Design Factors

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
- 03 Chemicals Metabolism and Toxicity
- 04 Other Environmental Pollutant Effects
- 01 Radiation Effects
- 02 Thermal Effects

55 BIOMEDICAL SCIENCES, BASIC STUDIES
- 30 Agriculture and Food Technology
- 01 Behavioral Biology
- 02 Biochemistry
- 03 Cytology
- 04 Genetics
- 06 Medicine
- 05 Metabolism
- 07 Microbiology
- 08 Morphology
- 09 Pathology
- 10 Physiological Systems
- 20 Public Health

40 CHEMISTRY
- 01 Analytical and Separations Chemistry
- 08 Combustion Chemistry
- 04 Electrochemistry
- 02 Inorganic and Physical Chemistry
- 03 Organic Chemistry
- 05 Photochemistry
- 06 Radiation Chemistry
- 07 Radiochemistry and Nuclear Chemistry

01 COAL AND COAL PRODUCTS
- 05 By-Products
- 40 Combustion
- 09 Environmental Aspects
- 60 Health and Safety
- 50 Marketing and Economics
- 20 Mining
- 04 Processing
- 06 Properties
- 70 Regulations
- 10 Reserves and Exploration
- 30 Transport and Handling
- 08 Waste Management

20 ELECTRIC POWER ENGINEERING
- 02 Environmental Aspects
- 01 Power Plants and Power Generation
- 03 Power Transmission and Distribution

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
- 01 Buildings
- 09 Education and Public Relations
- 03 Industry and Agriculture
- 06 Municipalities and Community Systems
- 02 Transportation

30 ENERGY CONVERSION
- 02 EHD Generators
- 08 Electromechanical Converters
- 05 Fuel Cells
- 01 MHD Generators
- 04 Thermionic Converters
- 03 Thermoelectric Generators

29 ENERGY PLANNING AND POLICY
- 10 Conservation
- 80 Consumption and Utilization
- 02 Economics and Sociology
- 60 Electric Power
- 01 Energy Analysis and Modeling
- 03 Environment, Health, and Safety
- 40 Fossil Fuels
- 50 Hydrogen and Synthetic Fuels
- 04 Natural Resources
- 06 Nuclear Energy
- 30 Policy, Legislation, and Regulation
- 05 Research, Development, Demonstration, and Commercialization
- 20 Supply, Demand, and Forecasting
- 07 Transport and Storage
- 90 Unconventional Sources and Power Generation
- 08 Waste Heat Utilization

25 ENERGY STORAGE
- 09 Batteries
- 04 Capacitor Banks
- 08 Chemical
- 02 Compressed Gas
- 05 Flywheels
- 07 Liquefied Gas
- 01 Magnetic
- 03 Pumped Hydro
- 06 Thermal

42 ENGINEERING
- 10 Combustion Systems
- 08 Electronic Circuits and Devices
- 02 Facilities and Equipment
- 01 General Engineering
- 04 Heat Transfer and Fluid Flow
- 03 Lasers
- 30 Marine Engineering
- 05 Materials Testing
- 40 Pollution Control Equipment
- 50 Power Cycles
- 06 Safety Engineering
- 20 Underground Engineering
- 07 Vacuum Engineering
- 09 Waste Processing Plants and Equipment

52 ENVIRONMENTAL SCIENCES, AQUATIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL
- 01 Basic Studies
- 02 Chemicals Monitoring and Transport
- 03 Radioactive Materials Monitoring and Transport
- 06 Regulations
- 05 Site Resource and Use Studies
- 04 Thermal Effluents Monitoring and Transport

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES
- 02 Assessment of Energy Technologies
- 03 Environmental Impact Statements
- 01 Social and Economic Studies

45 EXPLOSIONS AND EXPLOSIVES
- 01 Chemical
- 03 Explosion Detection
- 02 Nuclear

70 FUSION ENERGY
- 02 Fusion Power Plant Technology
- 01 Plasma Research

06 FUSION FUELS
- 03 By-Products
- 09 Environmental Aspects
- 05 Health and Safety
- 02 Processing
- 08 Properties
- 06 Regulations and Policy
- 01 Sources
- 04 Transport and Storage
- 07 Waste Management

99 GENERAL AND MISCELLANEOUS
- 05 Civilian Defense
- 03 Information Handling
- 04 Law
- 01 Management
- 02 Mathematics and Computers

58 GEOSCIENCES
- 04 Geochemistry
- 01 Geology and Hydrology
- 02 Geophysics
- 03 Mineralogy, Petrology, and Rock Mechanics
- 05 Oceanography

15 GEOTHERMAL ENERGY
- 07 By-Products
- 10 Direct Energy Utilization
- 05 Economic and Financial Aspects
- 06 Environmental Aspects and Waste Disposal
- 02 Geology, Hydrology, and Geothermal Systems
- 20 Geothermal Data and Theory
- 09 Geothermal Engineering
- 03 Geothermal Exploration and Exploration Technology
- 08 Geothermal Power Plants
- 04 Legal and Institutional Aspects
- 01 Resource Status and Assessment

57 HEALTH AND SAFETY

13 HYDRO ENERGY
- 05 Economics and Management
- 06 Environmental Aspects
- 03 Plant Design and Operation
- 07 Power Conversion Systems
- 04 Regulations and Licensing
- 01 Resources and Availability
- 02 Site Geology and Meteorology

08 HYDROGEN
- 07 By-Products
- 09 Environmental Aspects
- 06 Industrial and Commercial Use
- 04 Marketing and Economics
- 01 Production
- 08 Properties
- 05 Safety
- 02 Storage
- 03 Transport

44 INSTRUMENTATION
- 03 Miscellaneous Instruments
- 02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
- 01 Radiation Instrumentation
- 04 Well Logging Instrumentation

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 03 Isotopic Power Supplies
- 01 Physical Isotope Separation
- 02 Radiation Sources

36 MATERIALS
- 02 Ceramics, Cermets, and Refractories
- 03 Composite Materials
- 01 Metals and Alloys
- 06 Other Materials
- 04 Polymers and Plastics

03 NATURAL GAS
- 09 Artificial Stimulation, Plowshare, etc.
- 40 Combustion
- 03 Drilling, Production, and Processing
- 08 Environmental Effects
- 02 Geology and Exploration
- 05 Health and Safety
- 06 Marketing and Economics
- 10 Policy, Legislation, and Regulation
- 04 Products and By-Products
- 30 Properties
- 01 Reserves
- 50 Storage
- 20 Transport, Pipelines, and Handling
- 07 Waste Management

05 NUCLEAR FUELS
- 06 By-Products
- 05 Enrichment
- 30 Environmental Aspects
- 02 Exploration
- 04 Feed Processing
- 07 Fuels Production and Properties
- 40 Health and Safety
- 10 Marketing and Economics
- 03 Mining
- 50 Regulations
- 01 Reserves
- 08 Spent Fuels Reprocessing
- 09 Transport and Storage
- 20 Waste Management

21 NUCLEAR POWER PLANTS
- 08 Economics
- 06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
- 05 Power Reactors, Breeding
- 03 Power Reactors, Non-Breeding, Graphite Moderated
- 01 Power Reactors, Non-Breeding, Light-Water Moderated, Boiling Water Cooled
- 02 Power Reactors, Non-Breeding, Light-Water Moderated, Non-Boiling Water Cooled
- 04 Power Reactors, Non-Breeding, Otherwise Moderated or Unmoderated
- 09 Process Heat Reactors
- 07 Regulation and Licensing

22 NUCLEAR REACTOR TECHNOLOGY
- 02 Components and Accessories
- 04 Control Systems
- 05 Environmental Aspects
- 03 Fuel Elements
- 07 Plutonium and Isotope Production Reactors
- 08 Propulsion Reactors
- 09 Reactor Safety
- 06 Research, Test, and Experimental Reactors
- 01 Theory and Calculation

04 OIL SHALES AND TAR SANDS
- 06 Direct Uses and By-Products
- 03 Drilling, Fracturing, and Mining
- 10 Environmental Aspects
- 07 Health and Safety
- 08 Marketing and Economics
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 20 Regulations
- 01 Reserves and Exploration
- 02 Site Geology and Hydrology
- 09 Waste Research and Management

09 OTHER SYNTHETIC AND NATURAL FUELS
- 02 Alcohol Fuels
- 06 Gaseous Waste Fuels
- 01 Hydrocarbon Fuels
- 03 Inorganic Hydrogen Compound Fuels
- 05 Liquid Waste Fuels
- 04 Solid Waste Fuels

43 PARTICLE ACCELERATORS
- 03 Auxiliaries and Components
- 02 Beam Dynamics, Field Calculations, and Ion Optics
- 01 Design, Development, and Operation
- 04 Storage Rings

02 PETROLEUM
- 50 Combustion
- 03 Drilling and Production
- 09 Environmental Aspects
- 02 Geology and Exploration
- 06 Health and Safety
- 07 Marketing and Economics
- 10 Policy, Legislation, and Regulation
- 04 Processing
- 05 Products and By-Products
- 30 Properties
- 01 Reserves
- 40 Storage
- 20 Transport, Pipelines, and Handling
- 08 Waste Management

64 PHYSICS RESEARCH
- 01 Astrophysics and Cosmology
- 02 Atmospheric Physics
- 03 Atomic, Molecular, and Chemical Physics
- 04 Fluid Physics
- 50 High Energy Physics

65 PHYSICS RESEARCH (CONT.)
- 90 Communication, Education, History, and Philosophy
- 80 Mathematical Physics
- 50 Medical Physics
- 10 Nuclear Physics
- 40 Radiation and Shielding Physics
- 60 Solid State Physics
- 70 Theoretical Physics

14 SOLAR ENERGY
- 03 Economics
- 04 Environmental, Legal, and Institutional Aspects
- 20 Heat Storage
- 08 Ocean Thermal Gradient Power Plants
- 06 Photovoltaic Power Plants
- 01 Resources and Availability
- 10 Solar Collectors and Concentrators
- 05 Solar Energy Conversion
- 09 Solar Radiation Utilization
- 07 Solar Thermal Power Plants

16 TIDAL POWER
- 04 Economics
- 05 Environmental Aspects
- 03 Regulations
- 07 Tidal Power Plants
- 08 Wave Energy Converters

17 WIND ENERGY
- 01 Availability (Climatology)
- 04 Economics
- 05 Environmental Aspects
- 03 Regulations
- 06 Wind Energy Engineering

CORPORATE INDEX

AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

ERRATA

Vol.	Issue	Replace Bibliographic Citation with:
2	24	**58555** (LA-UR–77-1394) **Availability analysis for high reliability computer systems in nuclear facilities.** Schelonka, E.P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1977. Contract W-7405-ENG-36. 13p. (CONF-770656–19). Dep. NTIS, PC A02/MF A01.
3	2	**10430** (AWRE–44/91/87) **Computer code for SEURBNUK-2 for fast reactor explosion containment safety studies.** Cameron, I.G.; Hankin, B.C.; Warham, A.G.P.; Benuzzi, A.; Yerkess, A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment; Commission of the European Communities, Ispra (Italy). Joint Research Centre). May 1977. 26p. (TRG-Report–3006(R/X); JRC-ISPRA-ET–02/77). Dep. NTIS (US Sales Only), PC A03/MF A01.
4	7	**15034** (CONF-780485–8) **Coal pile leachate.** Hill, G.F. (Gilbert/Commonwealth, Reading, PA (USA)). 1978. 6p. Gilbert/Commonwealth, Reading, PA.
4	9	**21304** (AED-Conf–77-564-002) **Fluidized-bed combustion.** Schilling, H.D. (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). 1977. 24p. (In German). (CONF-7711102–1). Dep. NTIS (US Sales Only), PC A02/MF A01.
5	10	**14757** (DOE/ET/00222–T2) **Exploratory research on mutagenic activity of coal-related materials. Progress report, November 1, 1979-February 29, 1980.** Warshawsky, D.; Schoeny, R.S. (Cincinnati Univ., OH (USA). Dept. of Environmental Health). 1980. Contract EW-78-S-22-0222. 8p. Dep. NTIS, PC A02/MF A01.
5	20	**32192** (FE–2357-70(Vol.B)) **PFB Coal Fired Combined Cycle Development Program. Advanced cleanup device performance design report (Task 4.3). Volume B. Air shield cyclone evaluation.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Mar 1980. Contract AC01-76ET10377. 61p. NTIS, PC A04/MF A01.
6	2	**2133** (DOE/ET/20039–20) **Methane generation from cattle residue at a dirt feedlot. Final report.** Lizdas, D.J.; Coe, W.B.; Turk, M.; Fowler, F.S. (Hamilton Standard, Windsor Locks, CT (USA)). Aug 1980. Contract AC02-76ET20039. 156p. NTIS, PC A08/MF A01.
6	2	**2291** (DOE/ET/15332–T3) **Compressor configuration and design optimization for the high reliability gas turbine. Final report.** (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). Sep 1980. Contract AC03-79ET15332. 128p. NTIS, PC A07/MF A01.
6	2	**2454** (DOE/PE–0021) **Reducing US oil vulnerability: energy policy for the 1980's.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation). 10 Nov 1980. 439p. NTIS, PC A19/MF A01.
6	4	**4519** (DOE/PE–0021(Exec. Summ.)) **Reducing US oil vulnerability: energy policy for the 1980's.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Policy and Evaluation). 10 Nov 1980. 40p. NTIS, PC A03/MF A01.
6	4	**4537** (DOE/LC/10036–T6) **Occidental vertical modified in situ process for the recovery of oil from oil shale: Phase II. Quarterly progress report, June 1, 1980-August 31, 1980.** (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Sep 1980. Contract FC20-79LC10036. 315p. NTIS, PC A14/MF A01.
6	4	**4988** (NYSERDA–80-9) **Energy conservation potential in low-rise, high-density housing.** (Pratt Inst., Brooklyn, NY (USA)). Sep 1980. 221p. NYSERDA, Albany, NY.
6	7	**9034** **Control of gradient zone boundaries.** Nielsen, C.E. (Ohio State Univ., Columbus). pp 1010-1014 of SUN II. Boeer, K.W.; Glenn, B.H. (eds.). Elmsford, NY; Pergamon Press Inc. (1979).
6	7	**9789** (DOE/TIC–11391) **Nucleosynthesis of neutron-rich heavy nuclei during explosive helium burning in massive stars.** Blake, J.B.; Woosley, S.E.; Weaver, T.A.; Schramm, D.N. (Aerospace Corp., El Segundo, CA (USA)). 1 Jan 1981. Contract W-7405-ENG-48. 26p. (ATR-81(8454)-2). NTIS, A03/MF A01.

ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 16899

0104 Processing

REFER ALSO TO CITATION(S) 16396, 16418, 16607, 16608, 16609, 16610, 16611, 16612, 16615, 16615, 16695, 16921, 16921, 17089, 17183, 17906

16344 (CONF-800878—2) Memphis demonstration plant program. Patel, J.G.; Gray, R.W. (Institute of Gas Technology, Chicago, IL (USA)). 1980. Contract AC02-77ET13046. 17p. NTIS, PC A02/MF A01.

From 7. annual international conference on coal gasification, liquefaction, and conversion to electricity; Pittsburgh, PA, USA (5 Aug 1980).

Memphis Light, Gas and Water (MLGW) and the US Department of Energy (DOE) have a joint program to design, construct, and operate an industrial fuel gas demonstration plant in Memphis, Tennessee. The plant will use the Institute of Gas Technology's U-GAS Process to produce fuel gas equivalent to 50 million cubic feet per day of natural gas from 3200 tons of Western Kentucky coal. During Phase I of the program, main activities have been design of the plant, operation of the U-GAS pilot plant, the compilation of an environmental report and a definitive plant cost estimate. Phases II and III negotiations with DOE are being finalized. The total cost of Phases II and III is to be cost-shared by DOE and MLGW. The demonstration plant program's goal is to test the feasibility of a multiple-user coal gasification plant located in an urban area.

16345 (CONF-810402—9) Stress-corrosion cracking studies in coal-liquefaction systems. Baylor, V.B.; Keiser, J.R. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01.

From Corrosion/81 annual meeting; Toronto, Canada (6 Apr 1981).

Coal liquefaction plants with 6000 ton/d capacity are currently being planned by DOE as a step toward commercial production of synthetic fossil fuels. These plants will demonstrate the large-scale viability of the Solvent Refined Coal (SRC) process, which has been used since 1974 in two operating pilot plants: a 50-ton/d unit at Fort Lewis, Washington, and a 6-ton/d plant in Wilsonville, Alabama. Experience in these plants has shown that austenitic stainless steels are susceptible to stress corrosion cracking associated with residual stresses from cold working or welding. The corrodants responsible for the cracking have not yet been positively identified but are suspected to include polythionic acids and chlorides. To screen candidate materials of construction for resistance to stress corrosion cracking, racks of stressed U-bend specimens in welded and as-wrought conditions have been exposed at the Wilsonville and Fort Lewis SRC pilot plants. These studies have identified alloys that are suitable for critical plant applications.

16346 (DOE/ET/10254—88) Test and evaluate the tri-gas low-Btu coal-gasification process. Final report, October 21, 1977-October 31, 1980. Zabetakis, M.G. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Dec 1980. Contract AC21-78ET10254. 81p. NTIS, PC A05/MF A01.

This report describes the continuation of work done to develop the BCR TRI-GAS multiple fluidized-bed gasification process. The objective is the gasification of all ranks of coals with the only product being a clean, low-Btu fuel gas. Design and construction of a 100 lb/h process and equipment development unit (PEDU) was completed on the previous contract. The process consists of three fluid-bed reactors in series, each having a specific function: Stage 1 - pretreatment; Stage 2- - gasification; Stage 3 - maximization of carbon utilization. Under the present contract, 59 PEDU tests have been conducted. A number of these were single-stage tests, mostly in Stage 1; however, integrated PEDU tests were conducted with a western coal (Rosebud) and two eastern coals (Illinois No. 6 and Pittsburgh seam). Both Rosebud and Pittsburgh seam coals were gasified with the PEDU operating in the design mode. Operation with Illinois No. 6 seam coal was also very promising; however, time limitations precluded further testing with this coal. One of the crucial tasks was to operate the Stage 1 reactor to pretreat and devolatilize caking coals. By adding a small amount of air to the fluidizing gas, the caking properties of the coal can be eliminated. However, it was also desirable to release a high percentage of the volatile matter from the coal in this vessel. To accomplish this, the reactor had to be operated above the agglomerating temperature of caking coals. By maintaining a low ratio of fresh to treated coal, this objective was achieved. Both Illinois No. 6 and Pittsburgh seam coals were treated at temperatures of 800 to 900 F without agglomerating in the vessel.

16347 (DOE/ET/10280—T1) Impact of developing technology on indirect liquefaction. Gray, D.; Lytton, M.; Neuworth, M.; Tomlinson, G. (Mitre Corp., McLean, VA (USA). METREK Div.). Nov 1980. Contract AC01-77ET10280. 256p. (MTR—80W326). NTIS, PC A12/MF A01.

The status of commercial technology for indirect liquefaction, as exemplified by SASOL facilities in South Africa, is reviewed. The impact of substituting more advanced gasifiers and synthesis systems is then investigated. Slagging BGC/Lurgi, Texaco and Shell-Koppers gasifiers were substituted for the Dry Ash Lurgi units used at SASOL. SASOL SYNTHOL synthesis units were replaced by slurry phase Fischer-Tropsch units employing technology pioneered by Kolbel. The advanced systems were found to have a highly favorable impact on plant efficiency, product distribution and gasoline cost. If all the projected technical improvements can be realized for indirect liquefaction, the yields of refined transportation fuels per ton of coal will approach those anticipated for direct liquefaction processes.

16348 (DOE/ET/10296—71) Molten Salt Coal Gasification Process Development Unit. Phase 2. Quarterly technical progress report No. 2, October-December 1980. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). 20 Jan 1981. Contract AC03-77ET10296. 36p. NTIS, PC A03/MF A01.

This represents the second quarterly progress report on Phase 2 of the Molten Salt Coal Gasification Process Development Unit (PDU) Program. Phase 1 of this program started in March 1976 and included the design, construction, and initial operation of the PDU. On June 25, 1980, Phase 2 of the program was initiated. It covers a 1-year operations program utilizing the existing PDU and is planned to include five runs with a targeted total operating time of 9 weeks. During this report period, Run 6, the initial run of the Phase 2 program was completed. The gasification system was operated for a total of 95 h at pressures up to 10 atm. Average product gas HHV values of 100 Btu/scf were recorded during 10-atm operation, while gasifying coal at a rate of 1100 lb/h. The run was terminated when the melt overflow system plugged after 60 continuous hours of overflow. Following this run, melt withdrawal system revisions were made, basically by changing the orifice materials from Monofrax to an 80 Cobalt-20 Chromium alloy. By the end of the report period, the PDU was being prepared for Run 7.

16349 **(DOE/ET/10463—T1(Vol.2)) Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report.** Schrodt, J.T. (Kentucky Univ., Lexington (USA). Dept. of Chemical Engineering). 1 Feb 1981. Contract AS05-76ET10463. 329p. NTIS, PC A15/MF A01.

Three gasifier coal ashes were used as reactant/sorbents in batch fluidized-beds to remove hydrogen sulfide from hot, made-up fuel gases. It is predominantly the iron oxide in the ash that reacts with and removes the hydrogen sulfide; the sulfur reappears in ferrous sulfide. Sulfided ashes were regenerated by hot, fluidizing streams of oxygen in air; the sulfur is recovered as sulfur dioxide, exclusively. Ash sorption efficiency and sulfur capacity increase and stabilize after several cycles of use. These two parameters vary directly with the iron oxide content of the ash and process temperature, but are independent of particle size in the range 0.01 - 0.02 cm. A western Kentucky No. 9 ash containing 22 weight percent iron as iron oxide sorbed 4.3 weight percent sulfur at 1200°F with an ash sorption efficiency of 0.83 at ten percent breakthrough. A global, fluidized-bed, reaction rate model was fitted to the data and it was concluded that chemical kinetics is the controlling mechanism with a predicted activation energy of 19,600 Btu/lb mol. Iron oxide reduction and the water-gas-shift reaction were two side reactions that occurred during desulfurization. The regeneration reaction occurred very rapidly in the fluid-bed regime, and it is suspected that mass transfer is the controlling phenomenon.

16350 **(DOE/ET/13005—T2) Exxon catalytic coal-gasification process development program. Quarterly technical progress report, October-December 1979.** (Exxon Research and Engineering Co., Baytown, TX (USA)). Mar 1980. Contract AC01-78ET13005. 73p. (FE—2777-16). NTIS, PC A04/MF A01.

Work continued on the catalyst recovery screening studies to evaluate the economic impacts of alternative processing approaches and solid-liquid separation techniques. Equipment specifications have been completed for two cases with countercurrent water washing using rotary-drum filters for the solid-liquid separations. Material and energy balances have been completed for an alternative methane recovery process configuration using low pressure stripping which requires 26% less horsepower than the Study Design system. A study has been initiated to identify trace components which might be present in the CCG gas loop and to assess their potential impacts on the CCG process. This information will be used to assist in planning an appropriate series of analyses for the PDU gasifier effluent. A study has been initiated to evaluate the use of a small conventional steam reformer operating in parallel with a preheat furnace for heat input to the catalytic gasifier which avoids the potential problem of carbon laydown. Preliminary replies from ten manufacturers are being evaluated as part of a study to determine the types and performance of coal crushing equipment appropriate for commercial CCG plants. A material and energy balance computer model for the CCG reactor system has been completed. The new model will provide accurate, consistent and cost-efficient material and energy balances for the extensive laboratory guidance and process definition studies planned under the current program. Other activities are described briefly.

16351 **(DOE/ET/14674—T1) High-mass-flux coal gasifier. First quarterly technical progress report, 28 September-21 December 1979.** (Bell Aerospace Textron, Buffalo, NY (USA)). Feb 1980. Contract AC01-79ET14674. 23p. NTIS, PC A02/MF A01.

The objective of this program is to develop the High Mass Flux Gasifier for use in the production of SNG. For this specific application a secondary coal injection stage is added to the basic oxygen-blown, entrained-flow gasifier. This addition results in an enriched methane yield and reduced oxygen and steam consumption. Specific objectives for the initial phase of development currently under contract are to: demonstrate the feasibility of the Bell HMF Gasifier as a viable reactor for efficient production of synthesis gas in a steam using bituminous coal, oxygen and steam; and evaluate the feasibility of injecting secondary coal as a means of producing a methane enriched gas. To accomplish these objectives a program comprised of the following major tasks has been defined: design and construction of a 0.5 ton of coal per hour, 15 atmosphere pressure, coal gasifier with a secondary coal injection stage; modification of the existing gasifier test facility to incorporate a pressurized slag tank, cyclone and condenser (These additions are required to facilitate collection and/or measurement of all reactor products and to effect a material balance closure); cold flow test program to develop a secondary coal injection system; and gasification tests to demonstrate the feasibility of the HMF gasifier as an efficient producer of synthesis gas and evaluate secondary coal injection. During subsequent phases of the program it is planned to evaluate methane generation at higher pressure (up to 750 psia) and to demonstrate the gasification process during continuous duration tests. Reactor and facility design tasks are approximately eighty percent completed and reactor and facility fabrication has been initiated.

16352 **(DOE/ET/14801—6) Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow column).** Ying, D.H.S.; Sivasubramanian, R.; Givens, E.N. (Air Products and Chemicals, Inc., Allentown, PA (USA)). May 1980. Contract AC01-79ET14801. 71p. NTIS, PC A04/MF A01.

This work is a continuation of studies on the fluid dynamics of 3-phase flow to support the design of the 6000 T/D dissolver for the SRC-I demonstration plant. This plant will employ vertical tubular reactors feeding slurry and gas concurrently upward through these vessels. This reactor is essentially an empty vessel with only a distributor plate located near the inlet. Because the commercial plant represents a considerable scale-up, this program is addressing the need for additional data on behavior of three phase systems in large vessels. Parameters are being studied at conditions that relate directly to the projected demonstration plant operating conditions. The results show that the liquid axial dispersion coefficient was independent of liquid velocity regardless of the presence of solids, the solids concentration and their particle size. Increasing gas velocity, however, increased the liquid dispersion coefficient in all conditions. All the results clearly indicated a decrease in liquid dispersion coefficient as well as liquid backmixing in the presence of solid particles. The predicted axial dispersion coefficients from this correlation agree reasonably well with our experimental values for the air/water system.

16353 **(DOE/ET/14801—9) Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow columns). Quarterly technical progress report, 1 April 1980-30 June 1980.** Ying, D.H.S.; Sivasubramanian, R.; Givens, E.N. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Aug 1980. Contract AC01-79ET14801. 54p. NTIS, PC A04/MF A01.

This work is a continuation of 3-phase flow to support the design of the 6000 T/D dissolver for the SRC-I demonstration plant. The 6000 T/D SRC-I demonstration plant will employ vertical tubular rectors feeding slurry and gas concurrently upward through these vessels. This reactor is essentially an empty vessel with only a distributor plate located near the inlet. Because the commercial plant represents a considerable scale-up, this program is addressing the need for additional data on behavior of three phase systems in large vessels. Parameters are being studied at conditions that relate directly to the projected demonstration plant operating conditions. Gas velocity is the key element to maintain solid particles in suspension. Above the critical gas velocity, defined as the minimum gas velocity to achieve full solids suspension, solid accumulation is practically independentt of gas velocity; however, it increases linearly with decreasing liquid velocity at a fixed gas input rate. The effect of liquid and gas velocities on solids accumulation was studied in a 5-inch diameter column using 60/80 mesh sand particles. The mass transfer coefficient, k/sub L/a, is reduced by 30% in the presence of solids at all gas velocities. Batch and continuous experiments were conducted to study oxygen transfer in air/water and air/water/sand systems. Results from the 5-inch diameter column show that k/sub L/a increases with gas velocity in both 2-phase and 3-phase systems. The results also indicate that the k/sub L/a is independent of column height for the 5-inch diameter column. The effect of the absence of a distributor on fluid dynamics could not be clearly determined because of an unusual liquid level surge behavior. Results from liquid dispersion experiments confirm the earlier conclusion that liquid velocity has no effect on axial dispersion coefficients.

16354 **(DOE/ET/14815—20) Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980.** Streeter, R.C. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). Feb 1981. Contract AC21-79ET14815. 155p. NTIS, PC A08/MF A01.

The objective of this program was to demonstrate the feasibility of employing a gas-phase, catalytic, fluidized-bed reactor to carry out the water-gas shift and methanation reactions simultaneously, without product gas recycle. The major portion of the experimental work involved PEDU-scale tests in a 6-inch ID reactor, operating at 1000 psig and temperatures in the range of 900 to 1000°F, with a nominal catalyst charge of one cubic foot. These tests included operation for extended time periods (35 to 40 hours) with feed H_2:CO ratios of 2:1 in the absence of steam, and 1:1 using steam:gas ratios of 0.1:1 to 0.2:1. Five different catalysts were evaluated. Bench-scale tests, each of approximately 10 days' duration, were also conducted. At H_2:CO = 2:1 (without steam), no significant carbon deposition occurred at temperatures of 800 and 950°F. At 1100°F, however, considerable carbon formation did occur, possibly due to the onset of CH_4 pyrolysis. At H_2:CO = 1:1 and 950°F, carbon deposition took place readily in the absence of steam. Small amounts of steam in the feed (e.g., steam:gas ratio = 0.1:1) were effective in inhibiting carbon formation, although larger amounts (steam:gas ratio = 0.5:1) resulted in deactivation and loss of metal surface area through sintering. Results of auxiliary studies at Brigham Young University (BYU) on rates of carbon formation and removal are also presented. As to the relative tendencies of the various catalysts to undergo carbon deposition, results of the BYU studies generally confirmed observations made during PEDU testing at BCR. Catalyst regeneration tests at BYU with 10 percent O_2 in N_2 showed that 80 to 96 percent of the original metal surface could be restored at temperatures of 572 to 662°F.

16355 (DOE/ET/14815—20, pp 83-144) **Investigation of carbon deposition on fluidized methanation catalysts. Appendix.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT). Feb 1981.

In Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980.

Nickel and nickel bimetallic catalysts considered for use in combined shift/methanation by BCR were investigated using gravimetric, adsorption and laboratory reactor measurements to determine rates of carbon deposition, rates of removal of carbon by oxygen, rates of deactivation by carbon deposits, and loss of metal surface area due to carbon deposits. Carbon deposition rates measured gravimetrically are lowest on BCR 3631 (Harshaw), 4189 (Johnson Matthey), and 4705 (UCI) and highest on BCR 3766 (Climax) and Ni/TiO_2 during reaction at H_2/CO = 1 or 2. The catalysts least prone to deposit carbon at 1 atm (Harshaw, Johnson Matthey, and UCI) are also most resistant to deactivation by carbon during reaction (H_2/CO = 1.3) at high pressure and temperatures (350 to 450°C or 662 to 842°F). All of the catalysts lose metal surface area when carbon is deposited; however, most (80 to 98%) of this surface area loss can be restored by regeneration in 10% air/N_2 at 300 to 350°C (572 to 662°F). In long term tests at 500°C (932°F), BCR 4438 and 4265 (UCI and Climax catalysts) are quite resistant to deactivation by carbon. However, the UCI catalyst appears to sinter. X-ray and TEM measurements provide evidence that filamentous carbon is formed and that nickel carbide is not formed during combined shift/methanation.

16356 **(DOE/MC/12186—126) Solids throttling valves for coal conversion and utilization development. Final report.** Sine, G.C. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Nov 1980. Contract AC21-79MC12186. 125p. NTIS, PC A06/MF A01.

A complete test system to test, evaluate, and develop control valves for slurry letdown service in coal liquefaction plants is needed. The site identified for the test system was the SRC II Pilot Plant located at Ft. Lewis, Washington. The US Department of Energy, Morgantown Energy Technology Center, requested a test system design that would enable testing of various configuration letdown valves that would be compatible with the existing facility and have minimum impact on Pilot Plant operations. Drawings and specifications for such a test system were prepared, coordinated with Ft. Lewis personnel, revised to reflect Ft. Lewis operating personnel comments, and approved for use by the Morgantown Energy Technology Center. These drawings and specifications will enable the test system to be built, installed, and integrated with the existing facility by a general contractor.

16357 **(DOE/MC/14522—1) Proceedings of the 2nd symposium on valves for coal conversion and utilization.** Maxfield, D.A. (ed.). (TRW Energy Systems Group, Morgantown, WV (USA)). Jan 1981. Contract AM21-80MC14522. 279p. (CONF-8010171—). NTIS, PC A13/MF A01.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

The 2nd symposium on valves for coal conversion and utilization was held October 15 to 17, 1980. It was sponsored by the US Department of Energy, Morgantown Energy Technology Center, in cooperation with the Valve Manufacturers Association. Seventeen papers have been entered individually into EDB and ERA. (LTN)

16358 (DOE/MC/14522—1, pp 5.1-5.10) **Valve requirements and experience in the H-coal liquefaction process.** Miller, W.R. (Ashland Synthetic Fuels, Inc., KY). Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

The needs and requirements for valves in the H-coal process are varied, but the largest number of valves are on-off valves, used infrequently and commonly called block valves. The block valves that are the most troublesome are those used in high-pressure, high-temperature erosive service, or the high-pressure, high-temperature slurry service. The need for reliable block valves in the H-Coal Plant (or any energy-conversion plant) is critical to its successful operation and, in particular, to our ability to isolate and remove components for maintenance and repair while the plant is in operation. Failure to produce reliable, long-lived block valves will markedly reduce operating time and grossly affect the economics of plant operations. An additional, but no less critical area, is that of control valves, particularly pressure-control or as commonly called letdown valves. The short life of letdown valves - tens of hours, which needs to be tens of weeks in a reliable and repeatable fashion - is a limiting factor in the successful testing of the H-coal process. Valve design, trim design, and material selection are being studied and varied as dictated by the high-pressure, high-temperature, erosive, corrosive nature of fluids being tested. A program is underway to address the highest temperature, highest pressure, and most severe location for letdown and block valves with the aim that resolution of this problem area will meet practically all block and letdown difficulties at the H-Coal Plant.

16359 (DOE/MC/14522—1, pp 6.1-6.6) **High-pressure slurry-letdown valve designs for Exxon Coal-Liquefaction Pilot Plant.** Platt, R.J. Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

This paper describes the equipment used for several critical high-pressure letdown-valve applications on the Exxon Coal-Liquefaction Pilot Plant (ECLP). These valves are used to reduce high-pressure reactor effluent slurry to low pressure. The process employed is the Exxon Donor-Solvent (EDS) process. Pilot plant throughput is 250 tons/day. The plant was designed to obtain scale-up data and perform component testing for use in a larger-size commercial EDS design. Operations in the 250 tons/day pilot plant are part of an integrated R and D program sponsored by government and industry. The US Department of Energy provides 50% of the funding through a unique government cost-sharing arrangement, the Cooperative Agreement. The remaining funding is provided by Exxon Co., USA, Electric Power Research Institute, Japan Coal-Liquefaction Development Company, Phillips Petroleum Company, ARCO Coal Company, and Ruhrkohle AG. The development program status for the project was recently reported.

16360 (DOE/MC/14522—1, pp 7.1-7.8) **Selection and experience to date with block valves for the Exxon Coal-Liquefaction Pilot Plant.** Basile, R.J. Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

The Exxon Donor-Solvent Coal-Liquefaction Process contains many severe services for block valves because of the high pressures, temperatures, and solids concentrations present in many of the process streams. In addition, the lack of satisfactory operating experience with slurry block valves at other coal-conversion pilot plants suggested that conventional wedge-type gate valves would not provide satisfactory service life in coal slurries. The valve selection criteria used for choosing slurry block valves for the Exxon Coal-Liquefaction Pilot Plant and valve experience to date are discussed.

16361 (DOE/MC/14522—1, pp 8.1-8.10) **Slurry-letdown and isolation-valve performance at the Fort Lewis SRC Pilot Plant.** Ackerman, C.D.; Canfield, D.R.; O'Toole, S.L. (Pittsburg and Midway Coal Mining Co., Ft. Lewis, WA). Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

Through the six years of operating history at Fort Lewis, there has been considerable improvement in the performance of the slurry-letdown valves. The increase in trim life from 4 days to a maximum of 100 days can be attributed to a combination of: (1) change in valve type, (2) improvement in trim materials, and (3) valve sizing. The severe valve applications of the SRC processes have not been experienced in other industries. Severe erosion and corrosion properties have caused seat leakage, and ash contained in the slurry has created sealing surface damage which makes current standard isolation and check valves unacceptable for reliable service. The experience to date is briefly reviewed.

16362 (DOE/MC/14522—1, pp 11.1-11.8) **Valve requirements for the ICGG pipeline gas demonstration plant.** West, W. Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

The ICGG Pipeline Gas Demonstration Plant utilizes processes licensed from seven separate process licensors. Included in the presentation are brief descriptions of the processes and related facilities from the unloading of the coal through to the delivery of the gaseous product into the pipeline and the interim storage of the by-products: Naphtha, No. 2 and 6 fuel oils, sulfur, and ammonia. Particular emphasis is placed on special valve requirements: lockhopper valves, valves for operation at high temperature and erosive conditions, pressure-reducing valves handling slurries at high pressure differentials and temperatures, and control valves functioning in high-velocity streams of high-temperature gas with entrained particulates. Estimated quantities of valves in standard and nonstandard categories are presented for both demonstration and commercial-scale plants.

16363 (DOE/MC/14522—1, pp 12.1-12.16) **Westinghouse fluidized-bed gasification process and valve requirements.** Arthurs, M.J.; Chelen, E.J.; Lester, W. Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

The Westinghouse pressurized fluidized-bed gasification process, under development since 1972, has operated in a 24 tonper-day process development unit for more than 7000 hours since 1975. Operation at design temperature and pressure has been achieved, using both air and oxygen, on reactive western as well as highly caking eastern coals. Reliable techniques have been developed for startup, shutdown, and full-load operation. In addition, operating data have been generated to assess the performance of components subjected to conditions expected in a pressurized fluidized-bed gasification process. In this paper, the test performance and assessment of some of the process valves are discussed.

16364 (DOE/MC/14522—1, pp 13.1-13.13) **BI-GAS gasification process and valve requirements.** Plut, F. Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

Control-valve operating experiences by type and process application relating to coal gasification at BI-GAS and CO_2 Acceptor facilities are discussed. The paper also will cover lockhopper service, high-pressure letdown service, low-pressure service, and high-temperature service with possible solutions to problem areas in valves by type and design-application considerations.

16365 (DOE/MC/14522—1, pp 14.1-14.25) **Materials for erosive valve applications.** Wright, I.G.; Shetty, D.K.; Peterson, J.H.; Clauer, A.H. Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

The erosion-corrosion behavior of a range of commercially-available and advanced cermet and ceramic materials in hot erosive slurry service and in a laboratory simulator is reported. In both types of conditions, low-binder WC-CoCr cermets were found to perform consistently well. Further laboratory screening tests indicated that some ceramics, notably SiC as a coating or in some massive forms, could offer erosion-corrosion resistance superior to that of WC-CoCr. The reproducibility of performance of the ceramics from batch to batch, or between sources, however, was very variable. Some of the factors affecting the erosion-corrosion behavior of these materials, and some of the considerations necessary in their selection and application in practical valves, are discussed further.

16366 (DOE/MC/14522—1, pp 18.1-18.20) **Panel discussion on throttle valves.** Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

16367 (DOE/MC/14522—1, pp 19.1-19.22) **Critical valve specifications and METC valve-testing projects.** Gardner, J.F. (Dept. of Energy, Morgantown, WV). Jan 1981.

From 2. symposium on valves for coal conversion and utilization; Morgantown, WV, USA (15 Oct 1980).

There is a wide diversity of processes for converting coal to energy and/or synthetic fuels. Each of these has its own set of mechanical details and range of process conditions. The demands placed on valves, however, are not as varied as it might appear. These demands have been summarized in a set of specifications for critical-service valves. These Critical Valve Specifications and their development are discussed. In addition, the METC projects and facilities for valve testing are reviewed.

16368 (DOE/METC/SP—111) **Ceramic corrosion/erosion project description.** Nakaishi, C.V.; Carpenter, L.K. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Feb 1981. 141p. NTIS, PC A07/MF A01.

As a part of the United States Department of Energy's High Temperature Turbine Technology Program, the Morgantown Energy Technology Center is participating in a Ceramics Corrosion/Erosion Materials Study. Objective is to create a technology base for ceramic materials which could be used by stationary gas power turbines operating with a high-temperature, coal-derived, low-Btu gas products of combustion environment. Two facilities are designed and installed to burn a varying low-Btu coal-derived gas in a controlled manner. This report contains the objectives and testing philosophy as well as the operating, specimen handling, and emergency procedures for the facilities. The facilities were checked out in August/September 1980. Testing is scheduled to begin in late 1980 with completion of 1000 hours of ceramic materials exposure to be completed by early 1981. Most of the enclosed is an update of two METC Information Releases (IR), i.e., IR 442 (1979) Test Plan for Ceramic Corrosion/Erosion Project, and IR 817 (1980) Ceramic Corrosion/Erosion Project Description.

16369 (DOE/METC/SP—129) **Test and evaluation of two Sigmon Corporation 6-inch Type K Ball Valves METC SOA Test Valve No. A-4 and METC SOA Test Valve No. B-4 for lockhopper service in coal conversion.** Gardner, J.F. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). 28 Feb 1981. 78p. NTIS, PC A05/MF A01.

Two 6-inch size Sigmon Corporation Type K Blocking Ball Valves were procured by the Department of Energy's Morgantown Energy Technology Center for Testing and Evaluation in State-of-the-Art (SOA) Lockhopper Valve Testing and Development Project. Significant difficulties were encountered when performing tests. Problems included excessive leakage rates, galling of valve seats and balls, and a broken valve stem. Testing was terminated very early in the planned test sequence. The manufacturer was consulted with extensively on the problems which occurred. Agree-

ments between the Department of Energy and the manufacturer for correction of the problem were made but rework was not completed by the manufacturer. In the tested configuration, the subject test valves are not recommended for severe service block and seal applications in coal conversion.

16370 **(DOE/OR/13405—T1) Creep of monolithic refractory materials. Final report.** McGee, T.D.; Smyth, J.R.; Bray, D.J. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Nov 1980. Contract AS05-78OR13402. 50p. (ISU-ERI-AMES—81402). NTIS, PC A03/MF A01.

Objective was to evaluate the creep behavior of refractory materials used in the linings of coal gasification process vessels. The work is subdivided into nine tasks: literature review, equipment and materials selection, specimen preparation, short-term creep measurements, analysis of test specimens, stress relaxation measurements, long-term creep measurements, data correlation, and consultation. Materials tested were Al_2O_3 generic refractory and neat concretes, calcium-aluminate cements, and aggregates.

16371 **(DOE/PC/30088—4) Coal-transformation chemistry. Fourth quarterly progress report.** Stock, L.M. (Chicago Univ., IL (USA)). 1980. Contract AC22-80PC30088. 41p. NTIS, PC A03/MF A01.

Pyrene, perylene, anthracene, 9,10-diphenylanthracene, naphthalene and biphenyl have been employed as electron transfer agents in the reduction of Illinois No. 6 coal with potassium in tetrahydrofuran. These electron transfer agents are about equally effective for the reduction of this coal at short reaction times (3 hours). We conclude that the anions of biphenyl and naphthalene achieve a greater degree of electron transfer to the coal molecules and that the use of these anions enhances the fragmentation reactions of the coal. Illinois No. 6 bituminous coal and Colorado subbituminous coal were reacted with potassium dissolved in a mixture of monoglyme and triglyme at -50°C. The reduction reaction proceeded via solvated electrons rather than by an electron transfer reaction. The coals were then alkylated with methyl iodide and their solubilities in tetrahydrofuran were determined. The Illinois coal reductively alkylated via solvated electrons was considerably less soluble in tetrahydrofuran than the same coal reductively alkylated with potassium and naphthalene in tetrahydrofuran. A sample of Illinois No. 6 coal which had been reductively butylated with n-butyl-1-^{13}C iodide was hydrolyzed. Carbon nmr spectroscopy of the hydrolyzed coal revealed that the resonances previously assigned either to the presence of n-butyl carboxylates or to n-butyl tertiary ethers were removed. This observation provides definite evidence that only carboxylates were present in the original alkylated product. Selective alkylation of the acidic hydroxyl groups in Illinois No. 6 coal was carried out using tetrabutylammonium hydroxide as a phase transfer catalyst and iodomethane or 1-iodobutane as alkylating agent as described by Liotta. The tetrahydrofuran solubility of the product was significantly improved in a reaction where reductively butylated coal was subsequently coal was subsequently methylated using Liotta's procedure.

16372 **(DOE/PC/30291—1) Volatile production during preignition coal history. Quarterly progress report, September 1980-December 1980.** (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Feb 1981. Contract AC22-80PC30291. 18p. NTIS, PC A02/MF A01.

The goal of this program is to determine the characteristic pyrolysis behavior of representative coals under laser heating. The use of CO_2 laser enables a controllable heating rate to be given to the coal particles as they pass through the laser beam. The development of such a laser heating diagnostic should prove to be an extremely valuable tool for generation of a data base necessary for the future design of coal burning facilities. The experimental configuration is illustrated. A dilute coal/gas stream, surrounded by an inert shield flow is passed through a laser beam from an Avco HPL CO_2 laser. Under a prescribed flux density, and thus heating rate, the particles pyrolyse. The gaseous products are sampled and subsequently analyzed (primarily by gas chromatography) for carbon conversion. Particle temperature is to be monitored by a two-color pyrometer and particle velocity evolution of the pyrolysis process can be determined. The data can then be correlated with a detailed kinetic and transport model, which will enable the representative kinetic parameters to be determined.

16373 **(EPRI-AP—1725) Economic evaluation of coal gasification for electric power generation (an update). Final report.** Beckman, R.; Hsu, W.; Joiner, J. (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Feb 1981. 188p. NTIS, PC A09/MF A01.

This report is an economic update of previous evaluations of various coal gasification and power generation systems. Capital and operating costs of all the systems have been escalated to mid-1978 dollars from their original mid-1976 basis. The processes studied included the Lurgi dry ash gasifier; the British Gas Corporation's Slagger; the Texaco entrained system; Combustion Engineering's two-stage entrained atmospheric pressure gasifier; Foster-Wheeler's two-stage entrained pressurized system; and the Tosco/HRI Tosco-Dyne process. For comparative purposes, a coal-fired steam electric generating station with stack gas desulfurization in subcritical and supercritical designs is also developed in this report. The plant sizes used in all of the screening studies are in the capacity range of 1000 MW to 1200 MW. These plants feed a constant coal rate equivalent to 10,000 tons/day of Illinois No. 6 coal. An annual average capacity factor of 70 percent is used to prepare a detailed analysis of operating costs for each study case. Operating costs are calculated for the first-year of operation and for an average cost during the 30-year plant life. The results of this study indicate that the installed plant costs have escalated by eleven to 19 percent from mid-1976 plant investment costs. Several more detailed results are given.

16374 **(EPRI-AP—1740(Vol.1)) Moving-bed gasification - combined-cycle control study. Volume 1: results and conclusions, Case 1 - air-blown dry-ash operation. Final report.** Ahner, D.J.; Brower, A.S.; Dawes, M.H.; Patel, A.S. (General Electric Co., Schenectady, NY (USA)). Mar 1981. 115p. NTIS, PC A06/MF A01.

A simulation study has been conducted to investigate the inherent process dynamics and required control strategies for an integrated coal gasification/combined cycle (GCC) power plant to operate successfully under load-changing conditions to meet power system requirements. The simulated GCC plant configuration is similar to the flowsheet developed in earlier EPRI economic studies (RP239), based on an air-blown, dry-ash, moving-bed gasifier of the Lurgi-type. A following GCC plant control study will be based on a Lurgi-type gasifier modified for oxygen-blown, slagging operations such as that being developed by British Gas Corporation. A large ditial computer simulation model of the GCC plant operating on a large utility power system network was developed to examine alternate plant control strategies. Gas turbine-lead and gasifier-lead control modes were evaluated with respect to power system requirements for daily load following, tie-line flow regulation with thermal backup, and frequency regulation. Inherent features of the gasifier led to unique process dynamics for the GCC plant. Sizeable transients were observed during load-changing operations, both in the fuel process and the steam system. However, the plant compensated effectively for such transients with a modified gas turbine-lead control strategy, by making use of fast-responding gas turbine controls and the large inherent volume of the fuel process. The results verify the capability of the GCC plant to operate with the fuel process closely integrated with the combined cycle plant under rapidly changing conditions. Furthermore, a GCC plant control strategy was developed which can successfully meet power sytem requirements within fuel system limitations, allowing an overall plant response rate of four (4) percent per minute.

16375 **(FE—2806-16) Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes.** (Institute of Gas Technology, Chicago, IL (USA)). Dec 1980. Contract AC21-78ET11330. 114p. NTIS, PC A06/MF A01.

Results are reported from three exploratory programs to improve the processing techniques for the removal, conversion, or recovery of sulfur and nitrogen compounds without gas quenching in coal gasification processes. The areas of investigation were the following: (1) fuel gas desulfurization, (2) catalytic ammonia decomposition in fuel gas streams, and (3) catalytic hydrolysis of carbonyl sulfide in fuel gas streams.

16376 (FE—2806-16, pp 3-59) **Section I: high-temperature desulfurization of fuel gases.** Dec 1980.

In Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes.

Results are reported in fuel gas desulfurization techniques in coal gasification processes. The goal of this investigation was to identify materials that could be added to regenerable metal oxide sorbents to increase elemental sulfur production during regeneration of the mixed sorbent with oxygen-containing streams. The seven materials tested were sodium, molybdenum, cobalt, nickel, chromia, zinc aluminate, and zinc chromite. Of these materials, sodium, chromia, zinc aluminate, and zinc chromite appear to be promising additives for further development. The overall reaction cycle to produce elemental sulfur with these additives in high-temperature fuel gas desulfurization processes is postulated. The SO_2 in the regeneration step comes from direct oxidation of the primary desulfurization agent. The fraction of the hydrogen sulfide removed from the fuel gas during the desulfurization step that can be practically converted to elemental sulfur during the regeneration steps using these additives is yet to be determined. The sodium cycle apparently provides nearly quantitative conversion of the hydrogen sulfide removed to elemental sulfur, but at the cost of hydrogen consumption. Zinc aluminate and zinc chromite also provide nearly quantitative conversion, but may require recycling of the regenerator product gas to reduce the sulfur dioxide partial pressure in the regenerator.

16377 **Relative merits of alternate linking techniques for underground coal gasification and their system design implications.** Gregg, D.W. (Lawrence Livermore Lab, Calif). *In Situ ;* **4**: No. 3, 207-236(1980).

A technical-economic analysis is made of the comparative merits of three linking techniques for underground coal gasification: countercurrent combustion, directional drilling, and electrolinking. None of these techniques emerges as being superior to the others for all applications, but rather each has its own specific set of physical parameters (coal conditions) that make it superior to the others under certain conditions. The system design implications are discussed, and a novel approach to underground gasification of thin coal seams is presented. 12 refs.

16378 **(LA-UR—81-764) Flash pyrolysis of coal through solar heating.** Beattie, W.H. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 22p. (CONF-810509—4). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

A laboratory technique for studying flash pyrolysis by radiantly heating small stationary samples of powdered coal with the beam of a carbon dioxide laser is described. With this technique flux levels equivalent to those available from solar furnaces are attainable, experimental parameters are easily controllable and experimental turn around time is short. The pyrolysis of a Western subbituminous coal was studied with laser and solar heating. The pyrolysis products were a gas composed principally of H_2, CH_4, CO, and CO_2, tar, and char. Under laser heating, the gas yield increased with flux up to about 250 W/cm^2. Under conditions of complete pyrolysis, tar and gas yields were inversely proportional to each other, and char yield was almost constant. Solar coal pyrolysis experiments at the White Sands Solar Furnace gave results in general agreement with the laser pyrolysis experiments, except that gas yields were higher.

16379 **(LBL—12152) Corrosion of metals in coal char environments.** Foerster, T.F.W.; Levy, A.V.; Newman, J.S. (Standard Oil Co. of California, San Francisco (USA); Lawrence Berkeley Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 36p. (CONF-810347—1). NTIS, PC A03/MF A01.

From NACE international conference on high temperature corrosion; San Diego, CA, USA (2 Mar 1981).

It is demonstrated that a layer of coal char covering a metal surface affects the sulfur and oxygen partial pressures at the metal surface and thus the rate and extent of corrosion. Experiments demonstrating the effect of char composition and depth and bulk gas composition and flow rate on the rate of sulfidation are carried out.

16380 **(LBL—12308) Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980.** Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Sep 1980. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01.

The present annual report summarizes quarterly reports and includes work performed during the last quarter of fiscal 1980. The first year of this project has just been completed and much of the time and effort has been concentrated on equipment building, assembling, testing, and on staffing. This, of course, has been more true in the areas of work with spectroscopic and high pressure equipment than in organic chemical reactions. More experimental results are therefore reported in the areas of hydrogen transfer mechanisms and catalysis and organo-metallic chemistry. A few of the significant results in these and other areas are the evidence for catalysis in hydrogen transfer from tetralin; a novel and possibly very important new synthesis of alkyl aromatics from benzene, carbon monoxide, and hydrogen; the study of coals in the transmission electron microscope identifying coal macerals, minerals and metals, and leading to the possibility of observing location of and catalytic influences on pyrolysis and hydrogenation at elevated temperatures; the finding that scales formed on deactivated cobalt-molybdena-alumina-hydrogenation catalysts contain not only metals from the liquid feedstocks, but also molybdenum sulfide which must derive from migration from the catalyst interior to and beyond the surface. Insights gained in mechanisms of pyrolysis, hydrogenation, hydrogen transfer, and indirect liquefaction of coal promise to lead to improving technology by defining problem areas and showing routes to by-pass problems.

16381 **(NP—25377) Desulfurization of coal by microbiological leaching. Final report, September 1, 1978-June 1, 1980.** Torma, A.E.; Murr, L.E. (New Mexico Inst. of Mining and Technology, Socorro (USA). Dept. of Metallurgy). Feb 1981. 62p. (EMD—2-67-3319). New Mexico Energy and Minerals Department, Santa Fe, NM.

The microbiological desulfurization of a high sulfur New Mexico (Carthage) coal has been investigated using an adapted strain of Thiobacillus ferrooxidans. Optimum conditions for this leaching were determined as: pH, 2.0; particle-size, -400 mesh (-37 μm); pulp density, 25%; and temperature, 35°C. Under these conditions approximately 90% of the pyritic sulfur can be removed in 10 days from a coal sample containing 3.43% total sulfur of which 1.95% is pyritic. The rate of oxygen mass transfer into the leach suspensions was also measured and was shown to exceed that required for the oxidation of the pyrite by a factor of three. To study the feasibility of this approach on a semi-industrial scale, larger-scale tank leaching experiments were also conducted. Repeating this program of leaching for an Ohio coal as a basis for comparison produced the same optimum pH, particle size, and pulp density at 35°C; and under these conditions 75% of the pyritic sulfur (about 5% of the sample weight) could be removed. The rate of oxygen mass transfer was also similar to the New Mexico coal experiments. From these results, a generalized flow sheet illustrating a possible scheme of pyrite leaching (removal) by the bacteria has been proposed. Finally, large pyrite cubes were cut and polished to expose the (100), (110), (111), and (112) crystal plane orientations. These regimes were separately leached under controlled conditions and it was observed that acid-ferric sulfate leaching is different from acid-bacterial leaching. In addition, leaching rates are different for the different crystal surface orientations.

16382 **(ORNL/MIT—321) Development of a packed-bed letdown valve for coal-liquefaction plants.** Hulseman, R.A.; Kemker, G.H. Jr.; Sciamanna, S.F. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Mar 1981. Contract W-7405-ENG-26. 58p. NTIS, PC A04/MF A01.

Pressure letdown of coal-liquefaction slurry from high-pressure (13.9 mPa or 2000 psig), high-temperature (730 K) reactor/dissolvers can be accomplished using a packed bed. This concept could resolve the severe erosion problem which accompanies the use of conventional valves. Three-phase slurry letdown was simu-

lated using two-phase [$H_2O(l)$-$N_2(g)$] cocurrent upflow, with packed-bed pressure drops to 8.3 mPa (1200 psig). A semiempirical model predicting the pressure gradient for two-phase, cocurrent upflow in a packed bed is presented. Packed-bed letdown-valve designs which control linear slurry velocity and thus minimize erosion are presented. Preliminary cost analysis indicates carbon steel is an acceptable packing material.

16383 **(ORNL/Sub—7685/1) Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant.** Frazier, G.C.; Faruqi, A. (Smithsonian Institution, Washington, DC (USA). Conservation-Analytical Lab.). Mar 1981. Contract W-7405-ENG-26. 90p. NTIS, PC A05/MF A01.

The SRC-II product naphtha, gas oil, and whole liquid product hydrotreating data base was reviewed for completeness and applicability to the design of the SRC-II Demonstration Plant. Primary data sources were the Chevron and the UOP experimental hydrotreating work and the PNL bioassay investigations on UOP hydrotreated samples. Secondary data were the hydrotreating data for both the EDS and the H-Coal liquid products. The SRC-II product hydrotreating data are sparse at this point, but in view of the fact that these data can be supplemented through correlation with the corresponding data for the EDS and H-Coal liquid fractions, it is concluded that a sufficient data base exists for the closure of a hydrotreating plant material balance at least in the hydrotreating severity range of the Phase 0 design goals. Little thermal property data appear in the literature for coal-derived liquids; thus it will be necessary to draw upon correlations developed in the petroleum industry for closure of the plant energy balance unless experimental thermal property data are forthcoming. An area of uncertainty and concern at this time is the extent to which the Demo Plant product mutagenicity would be reduced by hydrotreatment. Although bioassay tests were conducted on both moderately and severely hydrotreated SRC-II Pilot Plant gas oil, the Demo Plant product is expected to contain an appreciable fraction of 800°F$^+$ material, compared with the Pilot Plant product, which contained essentially no material in this higher boiling range.

16384 **(ORNL/TM—7581) Technical and economic evaluation of selected coal-liquefaction processes. Phase O. Preliminary screening evaluations.** Salmon, R.; Forrester, R.C. III; Singh, S.P.N.; Fisher, J.F.; Wham, R.M.; Thiel, S.W.; Meyer, J.P. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 197p. NTIS, PC A09/MF A01.

Preliminary scoping evaluations of ten conceptual coal liquefaction processes were made for the Department of Energy using available published information. Production costs calculated under a consistent set of economic criteria varied from $0.78 to $1.47/gal for gasoline in constant 1979 dollars. However, existing design documents showed little consistency as to status of process development, credibility of process design basis, completeness of design, or conservatism of cost estimation. We concluded that a more complete and thorough design study of each process would be necessary to achieve any degree of technical and economic consistency, and that it was therefore not possible to satisfy DOE's desire for consistent technical and economic comparisons in this type of preliminary scoping study.

16385 **(PB—80-210529) Effect of physical coal cleaning on sulfur content and variability. Final report, June 1978-April 1980.** Sargent, D.H.; Woodcock, B.A.; Vaill, J.R.; Strauss, J.B. (Versar, Inc., Springfield, VA (USA)). May 1980. Contract EPA-68-02-2136. 96p. NTIS, PC A05/MF A01.

The report gives results of a statistical analysis of the sulfur content and heating value data for 53 different coal-source/cleaning-plant combinations, both to document the operational effectiveness of commercial coal cleaning plants in reducing sulfur and enhancing heating value, and to define the effect of physical coal cleaning on sulfur variability. Cleaning plants, for which matched pairs of feed and product coal data were available, showed 24-50% reductions (from feed to product) in the mean lb/SO2 million Btu. These empirical data are consistent with the calculated performance of hypothetical coal cleaning plants.

16386 **(SAND—80-2579) Applications of reservoir simulation to in situ coal gasification.** Glass, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

The results of the Hanna IVB in situ coal gasification test suggest a relationship between the preignition high permeability zones and the subsequent flame front propagation. As a result, this paper addresses the problem of the effect of nonuniform permeability on the air flow patterns in a water saturated coal seam. Specifically, the nonuniformities addressed are those caused by: (1) the existence of horizontal high permeability zones in an otherwise homogeneous, isotropic coal; (2) the change in permeability and flow path caused by well completions and location; and (3) the existence of orthotropic permeability. The results indicate that the most favorable condition for reverse combustion linking in underground coal gasification exists when the process wells are aligned with the high permeability direction of an orthotropic coal. The results also demonstrate the importance of proper well completion.

16387 **(SAND—80-2664) Role of site characteristics in the control of underground coal gasification.** Bader, B.E.; Glass, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01.

Underground Coal Gasification (UCG) offers many potential economic and environmental advantages. Offsetting these advantages is the substantial lack of ability to control the UCG process. For example, only three elements of external process control have been utilized. These are: (1) injected gas composition; (2) injected gas flow rate; and (3) product gas pressure. Variation of these independent variables in UCG tests has resulted in mixed indications of their effectiveness. This study indicates other possible elements of control based on the results of recent field tests and modeling efforts. These elements are associated with the selection of the specific site where the process is conducted and with the design of the test itself. The results of previous UCG field tests have indicated that the conditions that exist in the coal seam and overburden before the start of the combustion process may dominate all other factors. These conditions are the geotechnical characteristics, such as faulting and groundwater hydrology, as well as the details of the test layout, well completions, and linking method. Evidence exists to support the thesis that these preignition conditions can be dominant factors in process control of in situ operations. The data from recent UCG tests have been analyzed with respect to the effect of the site geotechnical characterisics and the test design. The results indicate that geologic faulting, coal seam permeability distributions, well completions, and coal strength are important elements of control in the process behavior. Attempts to influence Hanna IVB by varying external process parameters could not overcome these effects. Similar results have been observed in other UCG tests.

16388 **(SAND—80-2878) Instrumentation and process control development for in situ coal gasification.** Love, S.L. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

This report describes (1) the results of calculations made to determine the influence of various permeability structures on reverse combustion linkage for UCG, and (2) the results of heavy oil fireflood mapping by the Controlled Source Audio Magnetotelluric (CSAMT) method proposed for UCG process mapping. A two-phase, two-dimension reservoir model called RESEV was used for the permeability effects work; the results indicate that high permeability horizontal zones, well completion and separation, and orthotropic permeability all have significant influence on the success of reverse combustion linkage. Specific conclusions are made which emphasize the need for careful site characterization and for proper well completions. Regarding the second activity, CSAMT-derived resistivity maps provided good descriptions of the progress of the fireflood, which is being conducted by BETC near Bartlette, KS. The combustion front apparently did not proceed in a uniform, radial manner.

16389 **(SAND—81-0968C) Instrumenting and evaluating large-scale in situ experiments.** Davidson, G.S.; Hommert, P.J. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 27p. (CONF-810417—3). NTIS, PC A03/MF A01.

From 90. AICHE national meeting; Houston, TX, USA (5 Apr 1981).

Research experiments in in situ combustion require extensive instrumentation coverage if they are to be adequately diagnosed. The instrumentation includes both process related and in situ reactor sensors. Specialized sensors that overcome some of the survivability problems associated with standard thermometry are described. In order to maximize the information from any such large scale instrumentation effort requires a computer based data acquisition system. The data acquisition developed at Sandia National Laboratories for use on in situ combustion experiments is discussed. The system contains features that allow it to be flexible in its ability to accomodate changes in experiment definition and that facilitate real-time validation and analysis of the data. Examples of the systems analysis capability include thermocouple diagnostics and extensive plotting routines.

16390 **(TR—80/031-001) Proceedings of the US Department of Energy's first technical contractors' conference on peat.** (System Development Corp., McLean, VA (USA); UOP, Inc., McLean, VA (USA)). 1980. Contract AC01-78ET10159. 374p. (CONF-8003134—). NTIS, PC A16/MF A01.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

The proceedings of the conference are included in this volume. Papers presented cover the following topics: peat resource, estimation for Alaska, Maine, Michigan, Minnesota, North Carolina, and South Carolina; peat gasification research; environmental and socioeconomic issues of peat development; and the ground radar penetration work of the Minnesota Department of Natural Resources. The purpose of the conference was to bring together state and industrial researchers who are currently receiving DOE support to provide a forum for technical information exchange and discussion. There are 17 articles published in this proceedings, 11 of which have been abstracted separately for inclusion in the Energy Data Base.

16391 **Reverse combustion in a borehole.** Aiman, W.R. (Lawrence Livermore Lab, Calif). *In Situ ;* **4**: No. 3, 261-285(1980).

Reverse combustion along a directionally-drilled, horizontal channel 76 mm in diameter was used during a field experiment on in situ coal gasification. Planning the field work required laboratory experiments, which are reported here. In the experiments, reverse combustion did not propagate when air was used as the feed gas despite attempts with numerous operating conditions. Reverse combustion did propagate when the feed-gas oxygen content was increased to 32%. Rates up to 130 /mu/m/s (11 m/d) were found. Reverse combustion also propagated when oil was added to the air stream. 22 refs.

16392 **Pyrite desulfurization by wet oxidation in alkaline solutions.** Chuang, K.C.; Chen, M.C.; Greer, R.T.; Markuszewski, R.; Sun, Y.; Wheelock, T.D. (US DOE, Ames, Iowa). *Chemical Engineering Communications ;* **7**: No. 1-3, 79-94(1980).

Particles of iron pyrites can be desulfurized by leaching them with a hot alkaline solution containing dissolved oxygen under pressure. As the reaction proceeds sulfur is extracted largely as soluble sulfates, and a shell of iron oxide is formed around a shrinking core of pyrite. The overall rate of the reaction seems to be controlled by diffusion of dissolved oxygen through the shell of iron oxide. This work is pertinent to the combustion of coal. 25 refs.

16393 **Coal gasification of a central heating plant.** Roback, J.J.. (Univ. of Minnesota, Minneapolis). pp 17, Section 23 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

The reasons for installing the two-stage FW-Stoic gasifier to provide steam and heat for the University of Minnesota, Duluth campus, are given. The installation and startup of the gasifier are descried in some detail, and some problems are mentioned briefly. The boiler can be operated on fuel gas or on the oil produced in the process. The oil can be stored and essentially acts as a flywheel for smoother operation or in emergencies. The chemical compositions of the fuel gas and oil are given. (LTN)

16394 **Evaluating and testing the coking properties of coal.** Zimmerman, R.E. San Francisco, CA; Miller Freeman Publications, Inc. (1979). 144p.

In connection with the Paul Weir Company's work as worldwide consultants on coal, it became apparent that there is a need for a concise manual describing various methods for evaluating the coking properties of coals and discussing the important tests used in making this evaluation. There is no one source of information on this subject; rather, data on coking coals come from many sources, i.e., various societies' proceedings, technical magazines, and textbooks on certain specialized areas. The amount of information available would fill a library. In 1961, the Paul Weir Company prepared a report of a similar title. The demand for it exceeded all expectations, and numerous copies had to be reproduced at various times. Much of the information in the original text still stands; however, there have been many changes in processes for determining the coking properties of coals, and new test procedures have been developed. As a result, this manual has been prepared. The main purpose of this manual is to provide the reader with a ready reference for the various standards involved in evaluating coking coals, including the coal classification standards used by the major exporting and importing countries. An extensive bibliography is included, which contains some of the most important references. Individual countries frequently have their own coking coal standards, and coal producers interested in selling coal to these countries should obtain their particular standards. We do not claim that this manual is a definitive textbook covering all the technical details and scientific data required by a specialist in coking coal technology. Rather, it is hoped that it will serve as a guide to acquaint nonspecialists with the things they should know to determine the coking properties of their coals and to give them some idea as to the value of their coals in the coking coal market.

0106 Properties

REFER ALSO TO CITATION(S) 16344, 16348, 16383, 16455

16395 **(CONF-810308—10) Novel method for controlled oxidation.** Benjamin, B.M.; Raaen, V.F. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From American Chemical Society symposium on the chemistry of engine combustion deposits; Atlanta, GA, USA (29 Mar 1981).

The purpose of this paper is to describe a novel method for the oxidative degradation of coal or other organic material. The procedure is potentially useful for structure determination. As originally conceived, this method was intended for use with aqueous potassium permanganate as oxidant, but it is equally applicable with other oxidizing agents. Sodium hyprochlorite can be substituted for $KMnO_4$ except that controlling the pH and monitoring the end pilot become more difficult. Results with potassium permanganate only are described here but sodium hypochlorite was tried. An advantageous feature of the method is the simultaneous removal of soluble products from further contact with oxidizing agent as the oxidizing agent attacks the substrate. In principle, the experimental approach resembles that of column chromatography. Any oxidative degradation of a natural product for structure determination is of little use if carried out too far; for example, to the smallest, most oxidation-resistant materials such as carbon dioxide, acetic acid, and benzoic acid. Potassium permanganate oxidations of reactive species such as coal and kerogen are particularly difficult to control. Partially oxidized fragments which go into solution can be attacked more effectively than the solid starting phase, a situation which results in loss of structural information. Another difficulty is that phe-

nolic materials can undergo coupling reactions thus generating larger molecules and giving misleading results due to a larger number of substituents. The procedure used is described.

16396 (DOE/PC/30013—3) Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, August-October 1980. Davis, A. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Feb 1981. Contract AC22-80PC30013. 48p. NTIS, PC A03/MF A01.

A total of 69 samples have been obtained from the Lower Kittanning seam in western Pennsylvania and eastern Ohio. The samples were taken from 39 sample sites and consist of 39 channel samples and 30 hand-picked vitrinites. A complex statistical analysis of petrographic, physical and chemical properties of these samples was performed in order to study their relationship with thermoplastic and liquefaction behavior. The parameters of the thermoplastic properties were obtained using a Gieseler plastometer. The liquefaction conversion with tetralin was determined in tubing bomb reactors at 400°C for 1 hour. Factor analysis on the whole sample population indicated that both liquefaction conversion and some of the measured thermoplastic properties are significantly related with rank. Temperature of softening and degree of fluidity, however, did not load on the rank component. ^{13}C nmr spectra were obtained for six of our vitrinite concentrates by the University of Utah. The aromaticities determined for fairly wide rank range of these samples varied only from 0.66 to 0.72. However the series showed progression from highly functional aromatic structure at low rank to one with little functionality at high rank. The spectra show no indication of a consistent loss in aliphatic oxygen. The surface areas and micropore volumes of two fractions, -20 and -100 mesh, of five vitrinite concentrates have been measured from CO_2 uptake at 25°C. An increase in these values is observed with decreasing particle size. Total open pore volumes were calculated from particle and helium densities.

16397 (IS-T—948) Application of selected chemical reactions to the organic chemistry of coal. Metzler, R.M. (Ames Lab., IA (USA)). Feb 1981. Contract W-7405-ENG-82. 78p. NTIS, PC A05/MF A01.

Thesis.

This thesis involved 3 separate efforts. In the first trimethylsilyl ethers of a series model compounds were synthesized and their ^{29}Si nmr spectra observed. This procedure was then used on the benzene soluble, pentane insoluble portion of Lovilia coal. The proton nmr showed approximately 30 percent of the protons present were silicon methyl protons, but the ^{29}Si nmr showed no signal. This was not a completely surprisingly result. Coal is only about 10 percent oxygen by weight, and only about half of that is present as hydroxyl groups. Therefore, the silicon concentration in the coal will be low and ^{29}Si makes up only 4.7 percent of the silicon atoms. It was then suggested and later proven that enhancement of the ^{29}Si signal could be accomplished using cross-polarization between ^{1}H and ^{29}Si in silyl hydrides. A series of dimethylsilyl ethers were synthesized and their ^{29}Si nmr observed using the technique of cross-polarization. These nmr were run in a 10 percent solution in benzene. These results show that the ^{29}Si nmr signals of aromatic and aliphatic ethers are much closer together in the case of dimethylsilyl ethers than they were in the case of trimethylsilyl ethers. The second and third parts involve the reaction of Grignard reagent and trimethyliodosilane with organosulfur compounds chosen as structural models of coal. (LTN)

16398 (PB—80-220775) Physical and chemical characterization of coal. Final report, May 1978-January 1980. Hamblen, D.G.; Solomon, P.R.; Hobbs, R.H. (United Technologies Research Center, East Hartford, CT (USA)). May 1980. Contract EPA-68-02-3116. 163p. NTIS, PC A08/MF A01.

The report describes an automated scanning electron microprobe method of analyzing sulfur forms and mineral matter in coal. The microprobe is used to measure the spatial distribution of a number of elements (including Fe, S, Si, Al, Ca, and K) on a scale where individual grains can be observed. These data are then analyzed to extract the following information: organic sulfur concentration; mineral sulfur concentration; total sulfur concentration; major mineral concentrations, including Al2O3, SiO2, K2O, and CaCO3; and stoichiometry of iron sulfide, FeSx. The procedure is fully automated: all of the above information is obtained on a 200 mg coal sample in less than 15 minutes. Sulfur forms and total sulfur were reproducible to within 0.1 wt%. In addition, estimates of the pyrite particle size for two coals were obtained from the spatial distribution of the Fe and S data, and these estimates are compared with the results of a washability study. A commercial elemental analyzer, evaluated for use in determining nitrogen in coal, gave results that were reproducible and accurate to within 3%.

16399 (Y/DK—263) UCC-ND procedures for analyses of coal, Oak Ridge installations. Plemons, R.E.; Hopwood, W.H. Jr.; Hamilton, J.H. (Oak Ridge Y-12 Plant, TN (USA)). Feb 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

For a number of years the Oak Ridge Y-12 Plant Laboratory has been analyzing coal predominately for the utilities department of the Y-12 Plant. All laboratory procedures, except a Leco sulfur method which used the Leco Instruction Manual as a reference, were written based on the ASTM coal analyses. Sulfur is analyzed at the present time by two methods, gravimetric and Leco. The laboratory has two major endeavors for monitoring the quality of its coal analyses. (1) A control program by the Plant Statistical Quality Control Department. Quality Control submits one sample for every nine samples submitted by the utilities departments and the laboratory analyzes a control sample along with the utilities samples. (2) An exchange program with the DOE Coal Analysis Laboratory in Bruceton, Pennsylvania. The Y-12 Laboratory submits to the DOE Coal Laboratory, on even numbered months, a sample that Y-12 has analyzed. The DOE Coal Laboratory submits, on odd numbered months, one of their analyzed samples to the Y-12 Plant Laboratory to be analyzed. The results of these control and exchange programs are monitored not only by laboratory personnel, but also by Statistical Quality Control personnel who provide statistical evaluations. After analysis and reporting of results, all utilities samples are retained by the laboratory until the coal contracts have been settled. The utilities departments have responsibility for the initiation and preparation of the coal samples. The samples normally received by the laboratory have been ground to 4-mesh, reduced to 0.5-gallon quantities, and sealed in air-tight containers. Sample identification numbers and a Request for Analysis are generated by the utilities departments.

16400 Chemistry and physics of coal utilization - 1980. Cooper, B.R.; Petrakis, L. (eds.). New York, NY; American Institute of Physics (1981). 485p. (CONF-8006116—).

From Conference on chemistry and physics of coal utilization; Morgantown, WV, USA (4 Jun 1980).

The Conference on the Chemistry and Physics of Coal Utilization was designed as an interdisciplinary conference centered on the physics and chemistry phenomena involved in coal utilization, including the chemistry and physics of coal itself. The Conference was designated as a Topical Conference of the American Physical Society, and was held on June 2-4, 1980, at the Lakeview Inn in Morgantown, West Virginia. It was primarily intended as a working conference for those already engaged in, or at least technically informed on, coal conversion and utilization research. The program consisted of lectures by 23 invited speakers and two panel discussions by invited experts. In addition there were two sessions at which a total of 49 poster contributions were presented. This volume contains the invited papers (with one exception), reports of the panel discussions, and abstracts for the poster contributions. The individual papers are entered individually into EDB from a tape prepared by the American Institute of Physics. (LTN)

16401 (ORNL-tr—4725) Nitrogenous substances and means of studying the molecular structure of fuels. Rakovskii, V.E. Translated from *Khimiya Tverdogo Topliva (Leningrad)* ; No. 4, 148-156(1969). 14p. NTIS, PC A02/MF A01.

Solid fuels, such as coal, are composed of high-molecular compounds. The genesis of the petrographic elements of coal is discussed. Studies of the nitrogeneous compounds are sorely needed. Products of thermolysis of fuels contain virtually no primary and secondary amines; all of the nitrogeneous compounds of the tars are pyridine bases. A scheme for the formation of these pyridine bases

and of heterocyclic compounds is proposed. The chemical composition of coal macerals and the structure of fractionated compounds in these macerals are considered. The composition of the humus is also discussed. (DLC)

0108 Waste Management

REFER ALSO TO CITATION(S) 16794, 16795

16402 **(DOE/ET/04502—7) Bio-oxidation of thiocyanates typical of coal conversion effluents. Final report.** Neufeld, R.D.; Mattson, L.; Lubon, P. (Pittsburgh Univ., PA (USA)). 8 Jan 1981. Contract AS02-77EV04502. 142p. (SETEC-CE—81-001). NTIS, PC A07/MF A01.

Thiocyanates have been found in most coal conversion and coke plant effluents. The objectives of this study were to develop data for the biological degradation fate kinetics of thiocyanate removal, and to develop material balance information for the fate of sulfur and nitrogen resulting from such bio-decomposition of aqueous thiocyanates. A literature review of thiocyanate bio-degradation indicates that while much biochemistry information is available, little information in the biological processing arena is known. Based on both batch and continuous culture experiments utilizing an activated sludge type of system with strictly thiocyanate degradating organisms, the specific utilization rate for SCN degradation was found to follow a substrate inhibition biokinetic relationship as: $d(SCN)/dt\text{-}X = 2.24/[1 + (5/SCN) + (SCN/1340)^6]$ where; $d(SCN)/dt\text{-}X$ = lb SCN used/lb biomass-day, SCN = mg/L SCN in effluent. The observed biomass sludge production rate was quantified as a function of sludge age in the bio-reactor. The major metabolic by-products of SCN aerobic biodegradation are ammonia and sulfate, with such formation being stochiometric with SCN. High levels of SCN in coal conversion and Stretford system effluents may lead to biological nitrification process requirements to be added to the wastetreatment scheme for compliance with BAT effluent ammonia discharge restrictions.

16403 **(DOE/ET/15492—T12) Laboratory/bench-scale testing and evaluation of the A.P.T. Dry-Plate Scrubber. Fourth quarterly technical progress report, December 1, 1980-February 28, 1981.** (Air Pollution Technology, Inc., San Diego, CA (USA)). 30 Mar 1981. Contract AC21-80ET15492. 48p. NTIS, PC A03/MF A01.

The A.P.T. Dry Plate Scrubber (DPS) uses a shallow, dense mobile bed of solid collector granules which move across a perforated plate. The gas stream containing fine particles and vapors is moved upward through the perforations to form high velocity gas jets. The fine particles are removed by inertial deposition onto the collector granules or by direct interception. Electrostatic forces also can be used to improve the collection efficiency and increase the adhesive forces between the particles and collectors. The DPS column consists of a series of collection stages (perforated plates) with the collectors either passing sequentially over each stage or being fed separately to each stage. The stages can be designed so as to promote the collection of large particles on the lower stages and the collection of fine particles and alkali vapors on the upper stages. The DPS is especially well suited for cleaning high temperature and pressure gases such as the effluent from a pressurized fluidized bed combustion (PFBC) process. The objective of this project is to conduct a bench scale experimental evaluation of the DPS at high temperature and pressure to determine its potential for controlling particulate and alkali vapor emissions from PFBC processes.

16404 **(DOE/IR/06355—T1) Pessel-AEL flue-gas desulfurization process. Final report.** (American Electronic Labs., Inc., Montgomeryville, PA (USA)). 1979. Contract FG01-78IR06355. 183p. NTIS, PC A09/MF A01.

This process was conceived as a fully regenerative method of Flue Gas Desulfurization, (FGD), by combining two basic reactions which, by themselves, had been known for a long time, but never utilized for FGD. In Reaction No. 1, the sulfur dioxide in the Flue Gas reacts with an aqueous solution of ferric ions, preferably made available by ferric sulfate. The SO_2 is oxidized to SO_3, which is absorbed as sulfuric acid in the solution. An equivalent amount of ferric sulfate is reduced to ferrous sulfate. While this reaction, in a flue gas environment comprising only about 0.5 volume percent of SO_2, proceeds slowly at room temperature, it can be greatly accelerated by heat. The investigations have revealed that the sulfuric acid formed in the scrubbing fluid exerts an inhibitive effect on the rate of the $SO_2 \rightarrow Fe^{+++}$ reaction. The inhibition increases with growing H_2SO_4 content. This fact was not known before. It is proposed to remove the sulfuric acid from the scrubbing fluid to a separate reservoir, preferably by electrodialysis. The feasibility of such transfer was shown. It is anticipated that the diluted acid thus transferred will be concentrated by evaporation, utilizing the stack gas heat, to produce a commercially useful and shippable acid. In Reaction No. 2, the ferrous sulfate is re-oxidized (regenerated) to ferric sulfate by oxygen, preferably supplied from air. Thus regenerated, the solution can undertake additional oxidation of sulfur dioxide in accordance with Reaction No. 1. By repeated cycling between Reactions No. 1 and No. 2, the process was conceived to be theoretically and practically fully regenerative.

16405 **(EPRI-CS—1579(Vol.3)(Add.)) Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report.** Garlanger, J.E.; Ingra, T.S. (Ardaman and Associates, Inc., Orlando, FL (USA)). Mar 1981. 30p. NTIS, PC A03/MF A01.

As a continuing part of the field evaluation of the Chiyoda Thoroughbred 121 (CT-121) flue gas desulfurization (FGD) gypsum stack at the Scholz Electric Generating Station of Gulf Power Company in Sneads, Florida, the stack and disposal area were monitored after shutdown of the FGD system for a one-year period beginning June 1979. The objectives of the study were to establish whether long-term changes occur in the geotechnical properties of stacked CT-121 FGD gypsum and to evaluate any changes in groundwater quality. Results are presented for geotechnical laboratory testing and visual inspections of CT-121 FGD gypsum from the stack. These tests results indicate no measurable long-term change in shear strength or permeability. Visual inspection of the stack found no significant change in the overall appearance or stability, further confirming the feasibility of utilizing stacking for permanent disposal of CT-121 FGD gypsum. Water quality results obtained after the one-year monitoring period are also presented. With the exception of two downstream monitoring wells, water quality in the aquifers near the disposal area has either remained unchanged or has improved slightly since shutdown of the FGD system.

16406 **(EPRI-CS—1736(Vol.2)) Construction materials for wet scrubbers. Volume 2. Final report.** Rosenberg, H.S.; Krause, H.H.; Nowacki, L.J.; Kistler, C.W.; Beavers, J.A.; Engdahl, R.B.; Dick, R.J.; Oxley, J.H. (Battelle Columbus Labs., OH (USA)). Mar 1981. 304p. NTIS, PC A14/MF A01.

This report is a comprehensive documentation and analysis of utility experience with materials of construction in full-scale lime and limestone wet fluidized gas desulfurization (FGD) systems. Information on field performance of construction materials was collected by site visits, by telephone and letter contacts with FGD system operators and equipment vendors and by literature searches. Information was collected on: prescrubbers, absorbers, spray nozzles, mist eliminators, reheaters, fans, ducts, expansion joints, dampers, stacks, storage silos, ball mills and slakers, pumps, piping and valves, tanks and thickness, agitators and rakes, vacuum filters and centrifuges, and pond linings. Materials documentation and analysis includes successes, failures, reasons for success or failure, failure mechanisms, and relative costs of various materials. The results are designed to aid utilities and FGD equipment suppliers in selecting materials that aid will perform satisfactorily without unnecessary expense. Outlet ducts downstream from the outlet dampers and stack linings have a significant history of materials problems and are critical components - failures may require complete boiler shutdown and loss of generating capacity for lengthy periods. Prescrubbers, absorbers, reheaters, outlet ducts stream of the outlet dampers, dampers, pumps, and piping and valves have a moderate history of materials problems, but failures may not require complete boiler shutdown. Spray nozzles, mist eliminators, fans, inlet and bypass ducts, expansion joints, storage silos, ball mills and slakers, tanks and thickeners, agitators and rakes, vacuum filters and centrifuges, and pond linings have a relatively low histo-

ry of materials problems and/or are amenable to rapid repair or replacement.

16407 **(EPRI-CS—1738) Aqueous carbonate process test requirements document. Final report.** Binns, D.R.; Martin, L.W.; Weston, K.J. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Mar 1981. 68p. NTIS, PC A04/MF A01.

The testing and data collection requirements of all the cosponsors of the Aqueous Carbonate Process (ACP) Demonstration were collected, summarized, and compared to the capabilities of the system as proposed by the supplier, Rockwell International (RI). Any differences noted were resolved by mutual agreement among the cosponsors and RI. The current configuration of the demonstration project accurately reflects the desires of the cosponsors.

16408 **(PB—80-211113) Surface mine spoil stability evaluation, interior coal province. Volume I-main report. Glossary of terms (appendix a) and annotated bibliography (appendix b). Contract research (final), September 1977-January 1979.** Miller, R.P.; Douglass, P.M.; Robinson, R.A.; Roberts, D.A.; Laprade, W.T. (Shannon and Wilson, Inc., Seattle, WA (USA)). Aug 1979. Contract J0275013. 330p. NTIS, PC A15/MF A01.

This two-volume report addresses slope stability of surface mine spoils within the interior coal Province. Sixteen mines were visited, pertinent data and samples were collected, and reported spoil instabilities were back-analyzed. Laboratory test results are compared to back-analyzed material properties. Available methods of slope stability analysis are reviewed and evaluated with respect to application to mine spoil stability evaluation and prediction. Correlation and tentative relationships among spoil material properties, highwall conditions, mining equipment and procedures and empirical observations are presented. Slope stability sensitivity plots illustrate the relative significance of various input parameters on stability, slope stability input parameters are correlated with site and mining conditions to identify the primary factors controlling spoil stability. Investigative methods, spoil stability enhancement techniques, spoil stability prediction procedures, and future study areas are discussed. Appendices include a glossary of terms, an annotated bibliography, details of mine visits, and detailed laboratory test procedures and results.

16409 **(PB—80-211121) Surface mine spoil stability evaluation, interior coal province. Volume II-details of mine visits and detailed procedures of laboratory testing (appendix c). Contract research (final), September 1977-January 1979.** Miller, R.P.; Douglass, P.M.; Robinson, R.A.; Roberts, D.A.; Laprade, W.T. (Shannon and Wilson, Inc., Seattle, WA (USA)). Aug 1979. Contract J0275013. 398p. NTIS, PC A17/MF A01.

This two-volume report addresses slope stability of surface mine spoils within the interior coal Province. Sixteen mines were visited, pertinent data and samples were collected, and reported spoil instabilities were back-analyzed. Laboratory test results are compared to back-analyzed material properties. Available methods of slope stability analysis are reviewed and evaluated with respect to application to mine spoil stability evaluation and prediction. Correlation and tentative relationships among spoil material properties, highwall conditions, mining equipment and procedures, and empirical observations are presented.

16410 **(PB—80-222409) Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979.** Santhanam, C.J.; Lunt, R.R.; Cooper, C.B.; Klimschmidt, D.E.; Bodek, I. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Mar 1980. Contract EPA-68-02-2654. 259p. NTIS, PC A12/MF A01.

The report, the third of five volumes, focuses on trends in generation of coal ash and FGD wastes (together comprising FGC wastes) and the characteristics of these wastes. With increasing use of coal, the generation of FGC wastes is expected to increased dramatically: to about 115 million tons of coal ash and 38.7 million tons of FGD wastes by the year 2000. Most of these wastes will be disposed of on land. Data on the chemical characteristics of fly ash, bottom ash, and both treated and untreated FGD wastes in this report include data on principle components, composition ranges for trace components, and leaching behavior. Based on the characteristics of FGD wastes, a categorization of these wastes is also presented. Ongoing programs on chemical characterization are assessed. The fundamental physical properties of FGC wastes are density, size, and crystal morphology. The critical physical and engineering properties are those relating to handling characteristics, placement and filling characteristics, long-term stability, and pollutant mobility. The report includes information on index properties, consistency-water retention, viscosity vs. water content, compaction/compression behavior, dewatering characteristics, strength parameters, permeability, and weathering characteristics. Further efforts in this area are recommended: key is data from full-scale disposal sites.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 16408, 16409, 16429, 16434, 17352, 17363, 17364, 17384, 17386, 17433, 17436, 17449

16411 **(FE—1231-25) Design optimization in underground coal systems. Volume VII. Prediction of mining subsidence and related parameters over longwall mining operations. Final technical report.** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mining and Minerals Engineering). 28 Feb 1981. Contract AC01-76ET10722. 125p. NTIS, PC A06/MF A01.

The damage from mining subsidence ranges from land settlement to severe structural damage to structures. As a result, the prediction and hence control of surface subsidence are imperative for any environmentally acceptable coal-mining operation. Subsidence prediction has been the goal of mining engineers for over a century. Many methods have been pursued, mainly in Europe, to achieve this objective by employing empirical solutions, mathematically derived profiles based on the theories of elasticity, visco-elasticity, visco-plasticity and the use of influence functions.

16412 **(PB—80-219280) Effects of subsidence from thick seam coal mining on hydrology. Open file report (final), July 1979-March 1980.** Moore, R.C.; Nawrocki, M.A. (Hittman Associates, Inc., Englewood, CO (USA)). 7 Mar 1980. Contract J0295012. 245p. NTIS, PC A11/MF A01.

The Bureau of Mines contracted a study to estimate what effects the underground mining of thick coal seams in the Western United States would have on the surrounding water resources. Potential coal fields in the Western United States where this type of mining might occur were identified. Foreign literature was searched for studies of effects on hydrology from thick seam underground coal mining. Based on the limited information obtained from the literature, estimates of the effects of this type of mining on the ground and surface water in the Western States were made.

16413 **(PB—80-219330) Environmental assessment: source test and evaluation report - Willman-Galusha (Ft. Snelling) low-Btu gasification. Final report, September 1978-December 1979.** Kilpatrick, M.P.; Magee, R.A.; Emmel, T.E.; Page, G.C. (Radian Corp., Austin, TX (USA)). May 1980. Contract EPA-68-02-2147. 609p. NTIS, PC A99/MF A01.

The report gives results of a source test and evaluation of a Wellman-Galusha gasifier at the U.S. Bureau of Mines' Twin Cities Metallurgy Research Center at Ft. Snelling. The gasifier is operated as part of the Bureau's investigation of the use of low-Btu gas as a fuel for iron ore pelletizing. Program objectives were to provide survey data from which a preliminary assessment of potential environmental impact could be made, and to identify potential problems which would require further characterization or pollution control technology implementation.

16414 **(PB—80-220502) Groundwater quality monitoring of western coal strip mining: preliminary designs for active mine sources of pollution.** Everett, L.G.; Hoylman, E.W. (General Electric Co., Santa Barbara, CA (USA). Center for Advanced Studies). Jun 1980. Contract EPA-68-03-2449. 116p. NTIS, PC A06/MF A01.

Three potential pollution source categories have been identified for Western coal strip mines. These sources include mine stockpiles, mine waters, and miscellaneous active mine sources. TEMPO's stepwise monitoring methodology (Todd et al., 1976) is used to develop groundwater quality monitoring designs for each source category. These designs include description of monitoring needs, alternative monitoring approaches, and preliminary recommendations. Generic and example case studies are presented for stockpile and mine water sources. General case considerations are given for miscellaneous sources. Unit cost estimates for the monitoring designs, based on preliminary recommendations, are given.

16415 **(PB—80-220635) Evaluation of the impact of Texas lignite development on Texas water resources. Technical completion report, 1 July 1976-30 September 1977.** Mathewson, C.C.; Cason, C.L. (Texas A and M Univ., College Station (USA). Water Resources Inst.). Jul 1980. Contracts DI-14-34-0001-7091;DI-14-34-0001-7092. 163p. NTIS, PC A08/MF A01.

Research into the potential impact of the development of the Texas lignite resources on both the surface and groundwater resources of Texas has produced three separate areas within the lignite belt which have varying capabilities of supporting lignite development. The northeastern section of the lignite belt has sufficient surface water resources and backup groundwater resources to allow extensive development of lignite. The central section will support mining and development, but care must be taken to conserve and regulate water use. The southwestern section of the lignite belt does not possess sufficient ground or surface water resource for much, if any, lignite development. The most water thrifty methods of production would have to be employed for even limited development.

16416 **(PB—80-221062) Coal and the environment abstract series: mine drainage bibliography 1929-1980. Final report.** Gleason, V.E. (Bituminous Coal Research, Inc., Monroeville, PA (USA)). May 1980. 197p. NTIS, PC A09/MF A01.

Some of the topics covered in this Bibliography are formation and effects of acid mine drainage; erosion sedimentation; sediment control technology; the effects of coal mining on ground water quality and on hydrology; and drainage from coal storage piles. In addition to the abstracts, this volume includes an Author Index and a General Index.

16417 (TR—80/031-001, pp 299-311) **Evaluation of environmental issues on the use of peat as an energy source.** Walters, A.; Richardson, S.; Irons, J. (UOP Inc./System Development Corp., McLean, VA). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

Environmental concerns about the use of peat for alternative energy production can be divided into those related to the peat resource development/reclamation phase and those related to the energy processing phase. Analyses indicate that the majority of environmental impacts will occur during the resource development/reclamation phase. Data were secured and reviewed data from the ten major peat resource states. These data included preliminary knowledge on the extent and ownership of their peat resources, energy development attitudes, environmental concerns, alternative energy programs, and other environmental factors affecting peat development. The states surveyed were Alaska, Minnesota, Michigan, Wisconsin, New York, Maine, North and South Carolina, Florida, and Louisiana. The review indicated that the states are generally taking a very cautious attitude towards peat development and that each potential project would be judged on its own merits. The results of this evaluation indicate that scale of development is a major determinant of the severity of environmental concerns. The land required to provide an adequate supply of peat for such a plant may be more than several orders of magnitude greater than that required to provide the equivalent amount of coal. Because of these large land requirements, the effects on the air, water, and terrestrial environment increase in severity and concern. The review also indicates that state environmental regulations concerning peatlands (or wetlands) vary considerably from state to state.

16418 **Groundwater quality near an underground coal gasification experiment.** Campbell, J.H.; Wang, F.T.; Mead, S.W.; Busby, J.F. (Lawrence Livermore Lab., CA). *Journal of Hydrology ;* **44**: 241-266(1979).

Groundwater sampling and analysis have been carried out at the site of an underground coal gasification experiment conducted near Gillette, Wyoming. Water from more than 12 wells in the vicinity of the experiment has been sampled before, during, and up to 25 months following gasification. Water samples were analyzed for a variety of characteristics, including the presence of 70 inorganic species, phenolic materials and volatile and semivolatile organics. We find a greatly increased concentration of organic materials, particularly phenols, just outside the burn boundary and a variety of inorganic species issuing from within the residual ash bed. All detectable contaminants rapidly decreased in concentration with distance, although above-background levels of some materials were detected 30 m (100 ft) from the burn zone within three days of the gasification. Several important contaminants showed a large decrease in concentration with time due, probably, to adsorption. Our results suggest a simple physical picture of the development of groundwater pollution near an underground coal gasifier.

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 16390, 16895

16419 **(EPRI-EA—673(Vol.2Pt.2)) Coal resource information. Volume 2, Part 2. Annotation of selected sources. Final report.** Eyster, J.M.; Klein, D.E.; Walton, D.R. (ICF, Inc., Washington, DC (USA)). Dec 1980. 532p. NTIS, PC A23/MF A01.

For volume 2 part 2, 352 documents were selected for an annotated bibliography on coal resource information. The documents were chosen to ensure representation of all 37 coal-bearing states. Documents selected for annotation were those with more recent information about the quantity and quality of coal reserves, as well as those that provided data on wide geographical areas. The annotations were selected and written in late 1977 and early 1978. An annotation form was developed to provide a consistent presentation and thorough review of the information contained in each source. The form is organized into four categories: (1) the data base, (2) the geologic and physiographic parameters, (3) coal characterization parameters, and (4) map data sources. Each of these categories is further broken down into sub-sections. For example, the section on geologic and physiographic parameters includes tonnage estimates, degree of geologic assurance, geographic boundary, mineability and economic features, and seam characteristics. The section on coal characterization parameters consists of the coal quality basis, coal quality data, analytical tests, and physical and chemical properties. In addition to the type of information in each document, the methods used to obtain that information are identified. The annotation form presents a description of the assumptions and key definitions, as well as a description of the statistical techniques used. The form also notes whether the document was based on recompiled information or on new data. The annotation forms are arranged alphabetically by author under separate headings for each state. This annotated bibliography serves as a good reference on major documents on coal resources in the United States.

16420 **(EPRI-EA—673(Vol.2Pt.3)) Coal resource information. Volume 2, Part 3. Bibliography. Final report.** Eyster, J.M.; Klein, D.E.; Walton, D.R. (ICF, Inc., Washington, DC (USA)). Dec 1980. 493p. NTIS, PC A21/MF A01.

In Part 3 of Volume 2, a bibliography is presented of over 4300 coal resource documents published through 1976 and early 1977 regarding the location, quality, and mineability of US coal. Materials consist of documents, reports, articles, and maps; the listings are cross-indexed by state, county, and other geographic designations; and a bibliography of bibliographies is included.

16421 (TR—80/031-001, pp 313-322) **Ground penetrating radar demonstration/evaluation in Minnesota.** Malterer, T.J. (Minnesota Department of Natural Resources, Hibbing). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

The Minnesota Department of Natural Resources (MDNR) conducted a demonstration/evaluation of the Ground Penetrating Radar (GPR) manufactured by Geophysical Survey Systems, Incorporated (GSSI). Using the GPR techniques on eastern US peat bogs, GSSI showed encouraging results for the delineation of peat depth. The purpose of the test survey was to evaluate the ground pulse radar techniques on Minnesota-type peats under a variety of conditions of access and ground cover. The scope of the field work consisted of a series of radar traverses under these three conditions: (1) antenna pulled along the ground; (2) antenna elevated manually; and (3) antenna elevated by helicopter. Preliminary results indicate: (1) the interface between peat and the underlying sand or silt can be accurately delineated; (2) peat thickness determined by radar correlates well with test boring data; (3) it appears that the peat/silt interface could be defined to a depth of nine feet when the antenna is held five feet off the ground; (4) if the minimum depth of economical peat removal is seven feet, then helicopter profiling could identify the areas of peat resources in a relatively short time; (5) our test demonstration indicates that a ground survey could average approximately 12 to 15 miles per day under the existing field conditions; (6) helicopter profiles appear feasible provided that the antenna is towed five feet off the ground in open areas for a minimum distance of 25 feet; and (7) the entire radar system with the exception of the graphic recorder will perform continuously in the sub-freezing temperatures.

16422 **Avoiding contamination of overburden drill samples.** *Bureau of Mines Technology News ;* No. 94, 1-2(Mar 1981).

Sample analyses of overburden sampled delineated zones of unusually high trace metal concentrations at 20-foot intervals from the surface. However, these analyses of the overburden and its resultant spoil also showed that the spoil contained more toxic trace metal than did the original overburden. This indicated sample contamination. Since the rotary drill stems were also 20 feet long, there was high likelihood that the trace metal contamination within the samples came from the drill stem joint lubricant. The lubricant has two components: a petroleum base and a metal additive. The petroleum base acts to seal the stem joints from leakage of compressed air. The metal additive resists the lock-up from excessive tightening of the joint. Zinc, lead, or copper are common metal additives. A minute portion of the grease was apparently released into the drilling pipe and forced out of the drill bit by air from the compressor, resulting in overburden chip samples being mixed with grease. The results indicate that only drill stem joint lubricant with non-metallic additives should be used when collecting overburden samples for trace element analysis.

0120 Mining

REFER ALSO TO CITATION(S) 16408, 16409, 16459, 16460, 16462, 16516

16423 **(BM-RI—8494) Inorganic cement for mine roof-bolt grouting.** Simpson, R.E.; Fraley, J.E.; Cox, D.J. (Bureau of Mines, Spokane, WA (USA). Spokane Research Center). 1980. 36p. Bureau of Mines, Washington, DC.

Beginning in 1972, fully grouted resin bolts were used in underground mines. An estimated 20 million resin bolts will be installed in 1980 owing to their apparent support improvement in most roof-bolt applications. Inorganic cements were tested to replace the resin at a lower cost while retaining the advantages of a grouted bolt. Although other inorganic materials were considered, all but portland and gypsum cements were rejected for reasons of availability, performance, or cost. Portland and gypsum-type cements were tested by the Bureau of Mines to select a fast-hardening, low-cost material that would anchor a roof bolt adequately to meet safety standards. An alpha-gypsum cement, accelerated with potassium sulfate, was selected as the best material because it had adequate pull strength at a desired set time of less than 5 minutes and was readily available.

16424 **(BM-TPR—111) Reducing dust at longwall shearers by confining the dust cloud to the face.** Kissell, F.; Jayaraman, N.; Taylor, C.; Jankowski, R. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). Feb 1981. 23p. Bureau of Mines, Washington, DC.

The Bureau of Mines has developed the shearer-clearer dust control system for longwall shearers. The system partitions the airflow around the shearer into a clean split and a contaminated split. The dust cloud is confined to the vicinity of the coal face, while the shearer operators remain in the clean split on the gob side of the machine. The shearer-clearer operates on the principle that each water spray moves air like a small fan and can be positioned to direct the dustry air toward the face. The hardware is inexpensive and can be installed in a single shift. It consists of several strategically mounted water sprays and one or more passive barriers. Laboratory testing indicates reductions in shearer operator dust exposure as high as 97%. Preliminary results indicate that considerable dust reductions at the shearer may also be obtained. In conjunction with the development of the shearer-clearer, dust surveys were conducted in three other mines to determine if some shearer spray systems currently in use partition the flow in a manner similar to the shearer-clearer, and if so, whether this partially accounts for markedly cleaner conditions on some longwalls. Results indicate this to be the case: a feature of the cleaner longwalls was a downwind orientation of their water sprays, which is a key element of the shearer-clearer system. The shearer-clearer system described was designed for an Eickhoff EDW 300 shearer working a 7-foot coal seam. Testing to date has concentrated on cutting directions counter to the primary airflow. It is expected that different systems will be required to accommodate the range of conditions occurring underground. Application to conditions different than those described is not likely to produce the same results.

16425 **(DOE/ET/11268—9) Feasibility of high recovery highwall mining equipment. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Jan 1981. Contract AC01-79ET11268. 188p. NTIS, PC A09/MF A01.

Three equipment systems exhibited significant promise: the RSV Miner, a surface longwall using standard underground equipment, and the variable angle auger. Other equipment systems showing considerable merit were the surface shortwall, and the two extended depth augers. Of the three most significant systems, the RSV Miner exhibits the greatest versatility and adaptability. It may be used competently in many surface mining applications and readily adapts to geologic anomalies and changing seam heights. The machine employs steering and guidance equipment and provides the necessary capabilities for extended depth operation. Safety is good, as no men are required to work underground. However, most important is the system's recovery factor of approximately 75% to 80% of the in-situ coal reserve within reach. The surface longwall system using standard underground equipment (preferably a ranging drum shearer in conjunction with shield supports) is most suited to either a trench mining or a modified area mining application. Both applications would allow the length of the face to be held constant. Another important consideration is legal requirements for a tailgate entry, which would necessitate additional equipment for development in a modified area mining application. When compared to surface shortwall, surface longwall exhibits higher productivity, a far greater equipment selection which allows system tailoring to geologic conditions, and greater roof control due to the significantly smaller section of overburden that must be supported. Recovery should approach, and possibly exceed, 90% of the coal in-place. The variable angle auger, which is currently only a concept, fills a very real need for which no other equipment is available at this time.

16426 **(DOE/ET/12543—1) Methods and costs of thin-seam mining. Final report, 25 September 1977-24 January 1979.** Finch, T.E.; Fidler, E.L. (Montana Coll. of Mineral Science and Technology, Butte (USA)). Feb 1981. Contract FG01-77ET12543. 147p. NTIS, PC A07/MF A01.

This report defines the state of the art (circa 1978) in removing thin coal seams associated with vastly thicker seams found in the surface coal mines of the western United States. New techniques are evaluated and an innovative method and machine is proposed. Western states resource recovery regulations are addressed

and representative mining operations are examined. Thin seam recovery is investigated through its effect on (1) overburden removal, (2) conventional seam extraction methods, and (3) innovative techniques. Equations and graphs are used to accommodate the variable stratigraphic positions in the mining sequence on which thin seams occur. Industrial concern and agency regulations provided the impetus for this study of total resource recovery. The results are a compendium of thin seam removal methods and costs. The work explains how the mining industry recovers thin coal seams in western surface mines where extremely thick seams naturally hold the most attention. It explains what new developments imply and where to look for new improvements and their probable adaptability.

16427 **(DOE/TIC—11444) Geophysical methods for coal seam variability detection in front of mining face. Report No. 1, state of the art report.** Zakolski, R. (Glowny Inst. Gornictwa, Katowice (Poland)). Jul 1980. 29p. NTIS, PC A03/MF A01.

Work performed under the Joint Reseach Project through the Maria Sklodowska-Curie Joint Fund.

Problems in detecting geologic faults or washouts in coal seams by the use of seismic waves are considered. For transmission, the shot point should not be greater than 500 m from the detection point. A minimum thickness of the seam for transmission is equivalent to the lower limit of thickness for mining. The interpretation of the results is more difficult for thick seams (25 m) and the resolution is lower. The throw of a fault should be equal to the seam thickness or greater; throws of half the thickness can be detected only in favorable conditions; the fault must not be parallel to the propagation. The nature of the fault or washout cannot usually be determined. Problems are even greater when use is made of reflected waves: shorter distances (< 250 m), inclination to seam plane must be 25 to 30° and angle of incidence at a plane of the seam is equal to the angle of reflection. The theory of such measurements is given, the use of models for interpretation considered; the availability of equipment; and the processing of the data are discussed. (LTN)

16428 **(DOE/TIC—11445) Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980.** Kidybinski, A. (Glowny Inst. Gornictwa, Katowice (Poland)). Dec 1980. 26p. NTIS, PC A03/MF A01.

Portions of document are illegible. Work performed under the USDI/CMI Joint Research Project through the Maria Sklodowska-Curie Joint Fund.

A group of Polish engineers visited the US as part of an international cooperation program. They used their instruments to measure the properties of the roof rocks in 4 American underground mines. The data are given in the report with formulae for calculating the rock properties. Suggestions for improved design of the penetrometer used in the measurements are made (mostly those were required because of the hardness of the rocks and to facilitate the taking of the data). (LTN)

16429 **(PB—80-207541) The application of advanced mine air monitoring techniques to mines using diesel powered equipment. Final report, 1 July 1978-31 July 1979.** Johnson, J.H.; Carlson, D.H.; Reinbold, E.O. (Michigan Technological Univ., Houghton (USA)). 31 Jul 1979. 191p. NTIS, PC A09/MF A01.

Stratification of exhaust from a load haul dump was studied in an 80-foot-long dead end heading located in the White Pine mine section designated for exhaust emission studies. The mine air monitoring laboratory was used to gather temperature and CO2 concentration data at 10 locations. The data substantiate the presence of strong buoyant forces of the hot exhaust gases that result in stratification in dead end headings. Diesel mine-vehicle emissions were monitored in the laboratory by a portable tailpipe emissions measurement apparatus assembled for in-mine use. The results were compared with simultaneous measurements by standard laboratory exhaust monitoring instruments. These results indicate that accurate field source quality control measurements can be obtained for CO2, CO, and NO but NO2 results were low for all engine conditions. Diesel pollutant concentration data from the Orchard Valley mine were analyzed and compared with data collected earlier in the White Pine and Brushy Creek mines. Lognormal frequency distributions and CO2-based concentration ratios and correlations were calculated. In the three mines compared, pollutant concentrations were distributed similarly, and concentrations appear to be controlled to present standards.

16430 **(PB—80-210222) Splice testing using a figure-s machine and a new shuttle car simulation. Open file report, 1 May 1978-30 April 1979.** Tomlinson, J.; Rusnak, T.; King, R.; Morley, L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). 31 Jul 1979. 44p. NTIS, PC A03/MF A01.

Shuttle car trailing cable splices were tested for resistance to failure upon being subjected to repeated bending, abrasion, and tensile shocks using a new testing method that closely simulates shuttle car induced stress. The results show that under normal stress, splices can be made to withstand the equivalent of 3 months of operational use. Restoring the tensile strength to the conductors is as critical as restoring flexibility. Splices in which the conductors are of slightly unequal length did not present as serious a workmanship problem as previously thought since test results show that the conductors tend to equalize when longer cables, in contrast to short cables employed in previous testing methods, were used. Dynamic recordings of cable tensile stresses are presented for a shuttle car and the new simulated testing method. Two simple but effective methods for removing insulation using a knife and a pair of pliers are described. None of the designs tested for a sacrificial splice covering were satisfactory.

16431 **(PB—80-219272) Geologic and engineering data acquisition for underground coal mine ground control. Contract research report, January 1976-November 1979.** Alison, D.R.; Ohlsson, E.T.; Whitney, K.T. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1980. Contract J0395010. 100p. NTIS, PC A05/MF A01.

This study was conducted using field interview methods to determine the data and information requirements of the underground coal mining industry to improve mine ground control procedures in existing and future mines. The establishment of a central geologic and engineering information resource center with computer searchable abstract files that can locate and supply descriptive and case-study literature addressing specific mining problems is recommended. A bibliography of underground coal mine ground control literature is included.

16432 **(PB—80-219454) Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 1. Summary report. Final report, 1974-76.** Krausse, H. (Illinois State Geological Survey, Urbana (USA)). Jun 1979. Contract H0242017. 67p. NTIS, PC A04/MF A01.

The objectives of this study were to find and describe geologic factors that influence roof conditions in underground mines. The primary method of study was detailed mapping in mines, supplemented by regional computer mapping using drill-hole data, close-range photogrammetry, physical testing of core samples, and clay mineralogical investigations of roof material. Over a period of 3 years, a large volume of data has been generated. The results are reported in two volumes. Volume 1 is a summary for general use of the major findings and conclusions; volume 2 includes a detailed account of the method of study, the data gathered, and the conclusions reached.

16433 **(PB—80-219462) Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 2. Detailed report. Final report, 1974-76.** Krausse, H.; Damberger, H.H.; Nelson, W.J. (Illinois State Geological Survey, Urbana (USA)). Jun 1979. Contract H0242017. 218p. NTIS, PC A10/MF A01.

This report summarizes the status of knowledge on the influence of the geologic and structural fabric of roof strata on roof stability in underground mines in the Herrin No. 6 coal. The report is based both on past investigations and on information collected during recent visits to active mines. The objectives of this study

were (1) to identify and describe geologic conditions that influence roof stability, (2) to relate roof performance to the geologic structure by detailed study within selected mines, (3) to present information on areal distribution of comparable geologic conditions that influence roof stability, (4) to compile from literature and files geotechnical data that pertain to roof stability, (5) to collect samples from study areas by diamond drilling, (6) to show how to recognize, both in mines and in diamond drill cores, the various geologic features that influence roof stability, and (7) to propose areas of future research on the subject.

16434 **Backfilling of cavities resulting from borehole mining.** *Bureau of Mines Technology News ;* No. 95, 1-2(Mar 1981).

The Bureau of Mines borehole mining system creates a cavity having a horizontal diameter of more than 50 feet. This cavity can be backfilled with much of the sand previously mined. The sand tailings or similar backfill material is dumped by a front end loader into a slurry mixing tank at the rate of about one ton every three minutes. Enough water is added to give a thick, but pumpable slurry. The slurry is pumped down the borehole through a string of 4-inch pipe to the cavity. After passing through a right elbow at the end of the pipe, the slurry is ejected through a nozzle. The resulting slurry jet emplaces the backfill at the outer wall of the cavity. To obtain an even distribution of fill in the cavity, the nozzle is slowly rotated. The nozzle and pipe assembly is supported from a turntable on the surface. The backfilling technique has been field tested.

16435 **Orient mine tragedy, Part II: the conditions were ripe for an explosion.** Lewis, R. *Mine Safety and Health ;* **6**: No. 1, 14-19(Jan 1981).

In this second article details of the grim rescue mission are recounted and the investigation into the cause of the explosion are discussed - probably cigarette smoking but possibly from an electric spark. The violence of the explosion is described graphically. (LTN)

16436 **Orient mine tragedy: the last shift before Christmas.** Lewis, R. *Mine Safety and Health ;* **5**: No. 6, 10-15(Nov 1980).

A methane explosion at the Orient No. 2 mine on December 21, 1951 is described, including mine rescue operations. One hundred and nineteen miners died. (LTN)

16437 **Cooperation, commitment add up to worker safety at two mines.** Howerton, D. *Mine Safety and Health ;* **5**: No. 5, 6-9(Sep 1980).

Two coal mines with nationally recognized safety records agree that safety survives in the last analysis through strong personal commitment. Peabody Coal Company's Dugger strip mine and Bethlehem's Mine No. 108 were awarded Sentinels of Safety trophies in 1978, for being the safest surface and underground coal mines in the country that year. Winning this award has little or nothing to do with luck. It has to do with years of cultivating safety until it is as natural to a miner as digging coal.

16438 **Even the safest-looking highwall may be as lethal as a rattlesnake.** Milan, N. *Mine Safety and Health ;* **5**: No. 5, 14-16(Sep 1980).

The dangers of collapse of or falls of loose rock from highwalls are described with examples of serious accidents. Suggestions for reducing problems are given. (LTN)

16439 **Metal/nonmetal safety program proves effective at many mines.** *Mine Safety and Health ;* **5**: No. 2, 2-9, 27(Mar 1980).

This is the second of two articles on a Mine Safety and Health Administration accident prevention program called the Program in Accident Reduction (PAR), which has been conducted for several years at certain metal and nonmetal mines. Over the years, the record has shown significant reductions in injury incidence rates at most mines at which mine managers, safety directors, union representatives and workers have actively supported the program. The article offers further illustrations of the considerable impact of PAR activities at some of the Nation's metal and nonmetal mines.

16440 **Selection of PAR mines based on several factors.** Kogut, J. *Mine Safety and Health ;* **5**: No. 2, 8, 28(Mar 1980).

The Mine Safety and Health Administration's Program in Accident Reduction (PAR) was created to offer professional safety assistance on a cooperative basis to those mining operations which accident and injury records have shown to have serious injury rates significantly above national rates for similar type mines. Generally, the first question asked by a miner manager who has been told that his operation has been designated for PAR involvement is, Why me. The selection process actually is both carefully considered and complex. It was developed by MSHA's Health and Safety Analysis Center. The article discusses criteria for selecting mines for special attention.

16441 **More mines make use of satellite imagery as a roof control tool.** Howerton, D. *Mine Safety and Health ;* **5**: No. 2, 16-18(Mar 1980).

Remote sensing through analysis of satellite imagery for detecting potential problems related to unstable mine roof condition is used today by hundreds of mining companies throughout the United States. And evidence of the concept's progress since its introduction to mining five years ago is the training being conducted by the Mine Safety and Health Administration (MSHA) for its enforcement personnel. Offered at the MSHA technical support centers in Pittsburgh and Denver, the training aims to educate all MSHA safety professionals in the application of remote sensing to mine safety. MSHA hopes to make known to the mining industry - coal and metal/nonmetal, underground and surface - its capability to help them use remote sensing techniques in solving ground support or roof control problems.

16442 **Mine safety analysis and training programs have impact in Kentucky.** *Mine Safety and Health ;* **4**: No. 6, 8-13(Jan 1980).

Kentucky's mine safety program, financed 80% by MHSA and 20% by the state, is described, with particular emphasis on safety training. (LTN)

16443 **For 110, the fine Avondale mine was a tomb.** Campbell, S. *Mine Safety and Health ;* **4**: No. 6, 17-21(Jan 1980).

The explosion and fire at the Avondale, PA, coal mines on September 6, 1869 is described. One hundred and ten men were killed. The accident led to new legislation in Pennsylvania, which provided for two outlets to each coal seam, prohibited the use of ventilation furnaces (which started the fire) and required inspection of mines and penalties for negligence. (LTN)

0130 Transport And Handling

16444 **(CONF-810203—7) Application of coal petrography to the evaluation of magnetically separated dry crushed coals.** Harris, L.A.; Hise, E.C. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From AIME annual meeting; Chicago, IL, USA (22 Feb 1981).

In the present study the open gradient magnetic separation method has been used to beneficiate the -30 + 100 mesh fraction of two high volatile bituminous coals. The evaluation of the effectiveness of the magnetic separation for cleaning these coals is the subject of this paper. Coal petrography in combination with scanning electron microscopy and x-ray diffractometry were used to characterize the magnetically separated coal fractions. These analyses revealed that the majority of the pyrite and non-pyrite minerals were concentrated in the positive magnetic susceptibility fractions. The bulk of the starting samples (~ 80 weight percent) were located in the negative magnetic susceptibility fractions and showed significant reductions in pyrite and non-pyritic minerals. The magnetic separation appears to effectively split the samples into relatively clean coal and refuse.

16445 **(DOE/ER/10466—1) Efficient ultrasonic grinding: a new technology for micron-sized coal. Final report, September 15, 1979-December 14, 1980.** Tarpley, W.B. Jr.; Howard, P.L.; Moulder, G.R. (Energy and Minerals Research Co., Exton, PA (USA)). Jan 1981. Contract AC02-79ER10466. 40p. NTIS, PC A03/MF A01.

To burn coal most efficiently and cleanly, much smaller particle sizes are needed than can now be ground economically. This project was performed to demonstrate the technical feasibility of using ultrasonics to enhance grinding below the standard plant grind of 75 microns, and to extrapolate from this laboratory work the ultrasonic energy requirements for production use. Successively improved laboratory arrays demonstrated a repeatable production of particulates from 2000-micron coal to the desired size ranges (approximately 35% below 7 microns, 95% below 44 microns) with selective liberation of ash and pyrite inclusions to facilitate removal, with equipment translatable to production use, and the possibility of only 37 kwh/ton energy input requirement.

16446 **(DOE/METC/SP—125) Kamyr P-D Series Full-Borne Ball Valve METC SOA Test Valve No. A-17 state-of-the-art lockhopper valve-testing and development project.** Gardner, J.F.; Hall, R.C.; Hornbeck, R.G.; Griffith, R.A.; Nutter, T.M.; Yost, T.M.; Vandergrift, T.; Gayheart, T.R.; Armstrong, D.L. (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center; TRW Energy Systems Group, Morgantown, WV (USA)). Feb 1981. Contract AM21-80MC14522. 20p. NTIS, PC A02/MF A01.

The Kamyr Ball Valve, METC SOA Test Valve No. A-17, accumulated 640 valve cycles in the Valve Static Test Unit and over 16,900 valve cycles in the Valve Dynamic Test Unit. During dynamic testing (with minus 8 mesh and 5/16" x 1/8" limestone), the stem packing was replaced twice and the valve was disassembled once to remove compacted fines from the body cavity. The seat leakage after testing was less than one-half of the rate allowed in the state-of-the-art project for a 6-inch valve. The inspection after testing showed sight abrasion and galling on the stem. With a suitable purge system to minimize the entry of fines into the stem packing and body cavity, this valve would be expected to have outstanding performance in lockhopper service with dry solids. Pilot-plant experience with a large valve (10-inch) from the same design series has shown that this design has the capability for a service life in excess of 10,000 cycles.

16447 **(EPRI-CS—1622) Impact of coal cleaning on the cost of new coal-fired power generation. Final report.** Folz, D.J.; Goodman, P.O.; Sybert, L. (Bechtel National, Inc., San Francisco, CA (USA)). Mar 1981. 376p. NTIS, PC A17/MF A01.

Seven hypothetical power-generation cases were studied to estimate the cost effect in each case of coal cleaning. Three levels of coal preparation - no cleaning, partial cleaning, and intensive cleaning - were used to perform the analysis. Two-unit, 1000-MW power plants operating at 70% average load factor were assumed. These power plants were designed to comply with the proposed NSPS for SO_2 emissions (85% removal/24-hour averaging) under the 1977 Clean Air Act Amendments. Diverse coals and plant locations were selected. The estimated capital costs of the coal cleaning plants were consistently less than 5% of the capital costs estimated for the corresponding power-plants. In 6 of the 7 study cases, the utilization of coal cleaning reduced overall capital costs, and in 5 cases the busbar-cost savings introduced by the use of cleaned coal more than offset the incremental cost of coal cleaning. In terms of 30-year levelized costs, the use of cleaned coal was estimated to be responsible for net busbar-cost savings of up to 2 mills/net kWh in the 5 cases where coal cleaning appeared cost effective. These results are considered conservative, since certain economic benefits of using cleaned coal (e.g., improved power plant availability and operability) were not included in the cost estimates due to lack of sufficient data.

16448 **(EPRI-WS—80-119) 1980 national conference and workshop on coal freezing.** Lansing, N.F. (ed.). (Electric Power Research Inst., Palo Alto, CA (USA)). Dec 1980. 286p. (CONF-8003133—). NTIS, PC A13/MF A01.

From Conference and workshop on problems of coal freezing; Cincinnati, OH, USA (31 Mar 1980).

A national conference and workshop on problems of coal freezing were sponsored by EPRI in Cincinnati, Ohio, on March 31 and April 1, 1980. For each of the following topics, the report includes the formal papers, a summary of the workshop discussions, and conclusions: standards for frozen coal tests, application of freeze conditioning additives, transportation problems of frozen coal, consumer perspectives on frozen coal problems, and development of methods for unloading frozen coal. Over 130 persons participated, representing all of the industries concerned with aspects of freezing coal: utilities and other consumers, transportation, mining, and suppliers of freeze-conditioning additives. The conclusions reached included: methods for evaluating freeze-conditioning additives (FCA) and for sampling coal to detect FCA; guidelines for designing and using FCA-application systems, which must be custom designed; and a catalog of specific problems from frozen coal, with a list and evaluation of possible solutions. The report also includes the available records from the 1979 Seminar on Frozen Coal Problems, which was held in St. Louis. Twenty-four papers have been entered individually into EDB. (LTN)

16449 **(PB—80-222565) Pacific bulk commodity transportation system, executive summary. Final report.** (Boeing Engineering and Construction Co., Seattle, WA (USA)). Jun 1980. Contract DO-A01-78-00-3038. 23p. NTIS, PC A02/MF A01.

A study was conducted of the feasibility of using slurry systems to carry Western U.S. steam coal to far Eastern Markets. The selected system consists of a pipeline for overland movement of slurried coal from Emory, Utah to Oxnard, California and large, special purpose ships to carry the coal to Japan, Korea, and Taiwan. The selected system was found to be able to deliver coal to far Eastern Markets at prices competitive with coal from Australia, and South Africa, and at prices $10 per ton cheaper than any other U.S. alternative.

16450 **(PB—80-222573) Pacific bulk commodity transportation system, Volume II. final report.** (Boeing Engineering and Construction Co., Seattle, WA (USA)). Jun 1980. Contract DO-A01-78-00-3038. 448p. NTIS, PC A19/MF A01.

A study was conducted of the feasibility of using slurry systems to carry western U.S. steam coal to far Eastern Markets. The selected system consists of a pipeline for overland movement of slurried coal from Emory, Utah to Oxnard, California, and large, special purpose ships to carry the coal to Japan, Korea, and Taiwan. The selected system was found to be able to deliver coal to far Eastern Markets at prices competitive with coals from Australia, China, and South Africa, and at prices $10 per ton cheaper than any other U.S. alternative.

16451 **Hopper popper.** Hastings, M.R. (Long-Airdox Co., Oak Hill, WV). pp 9, Section 22 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Experience in developing drilling equipment for drilling into the frozen coal (either in railway cars or stockpiles) and then loosening the coal by an air shot of about 400 cubic inches at 2000 to 8000 psi is described. It was difficult to drill into the frozen coal and to mount the drilling equipment so that it was stable. Previous methods of loosening frozen coal are discussed briefly. (LTN)

0140 Combustion

REFER ALSO TO CITATION(S) 16389, 16793, 16941, 16958, 17202, 17239, 17240

16452 **(ANL/ECT-TM—3) Coal-oil-mixture technology: a status report.** Lecky, J.A. (Argonne National Lab., IL (USA)). Oct 1980. Contract W-31-109-ENG-38. 54p. NTIS, PC A04/MF A01.

Papers and discussions presented at the Second International Symposium on Coal-Oil-Mixture Combustion (November 27 to 29,

1979) are reviewed to assess the state of technology in this field. Environmental problems receive little attention; most appear soluble by current methods used to control emissions from coal burning. Economic studies indicate that converting oil-burning plants to COM burning would be profitable, even with retrofit costs. Experience with coal-oil mixtures (COM) has been encouraging in bench-scale tests, small boilers, and short-term plant tests, but extended, large-scale tests are needed prior to commercialization of COM. Major problems needing more investigation or plant experience are: lack of a definition of COM stability and a quick way to measure it; uncertainties as to COM structure and the mechanisms of how additives promote stability; heterogeneity of coals and oils; inadequate experience in COM storage and transportation; uncertainty about long-term effects of corrosion and erosion of components by COM, and existence of other possible operating problems. The US Department of Energy announced an expanded program for COM demonstration plants, and industrial firms are selling COM and offering to build plants to prepare it.

16453 **(DOE/ER/10456—2) Condensation processes in coal-combustion products. Progress report, July 1, 1980-June 30, 1981.** Katz, J.L.; Donohue, M. (Johns Hopkins Univ., Baltimore, MD (USA)). Apr 1981. Contract AS02-79ER10456. 16p. NTIS, PC A02/MF A01.

Slag vaporization is a serious problem in high-temperature coal combustion and gasification processes. Cooling of process gas streams causes the slag vapors to condense, but they do not necessarily do so at equilibrium. Predicting the compositions and properties of the condensing species requires modeling these nucleation processes occurring in these systems. This is a report of our progress toward modeling the nucleation processes, implementing the model with a computer code suitable for design calculations, and testing the model with appropriate experiments.

16454 **(DOE/TIC—11441) Reactions of HS radicals important in coal combustion. Project status report, January 1-March 31, 1981.** (Los Alamos National Lab., NM (USA)). 7 Apr 1981. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01.

HS radicals are generated in sizable concentration via the photolysis of H_2S by either an ArF or a KrF laser. The fate of the ground state HS radicals is then monitored by exciting the $A^2\Sigma^+$ - X^2PI transition of HS via the laser-induced fluorescence (LIF) technique. Our present experimental set up is basically the same as described previously but with some very important modifications. Essentially, either the ArF or KrF laser is used as the source of photodissociation, and a tunable frequency doubled flash-lamp-pumped dye laser (CMX-4) or a frequency doubled Nd:YAG laser pump dye laser is used as the probe laser. It is important to note that with the addition of the YAG-pumped dye laser system, both the signal sensitivity and time resolution of the detection scheme are improved by better than one order of magnitude because of the short pulse and high energy output characteristics of the YAG laser system. The induced fluorescence signal from the selected radical species is monitored spectrally through a monochromator. Both LIF and the dye-laser signals are averaged in a transient digitizer and are ratioed so that a normalized LIF signal amplitude can be obtained. The delay times between the photolysis laser and the probe laser are varied by a programmable BNC pulse delay generator, and the time delays are determined by the use of a second transient digitizer via optical-triggering devices. Time history of the HS radicals under selected experimental conditions can then be characterized. Both the laser fluences and species concentrations can be adjusted to ensure the measurement of the desired reactive process. All experiments are carried out in a temperature-controllable reaction cell. Results are described briefly.

16455 **(EPRI-CS—1695) Structure and stability of coal-oil mixtures and coal-water mixtures. Final report.** Rowell, R.L. (Massachusetts Univ., Amherst (USA). Dept. of Chemistry). Feb 1981. 47p. NTIS, PC A03/MF A01.

The objectives of this study were (1) to increase the understanding of the structure and stability of coal-oil mixtures (COM), and (2) to devise devices, stabilizers and processes useful to the development of this technology. It was found that a desirable COM dispersion was a loosely flocculated network of coal particles that gave a homogeneous system that yielded readily to flow. Stability can be broadly defined as invariance of state properties and the work dealt mainly with static stability. The subsidence technique illustrated the concept of critical solids concentration and showed the effect of water as a dispersant in coal-mineral oil mixtures. Pycnometric measurements showed that the true coal density could be obtained by extrapolation to infinite dilution. Another finding was that the desirable effects of additives on COM stability were negated by exposure of the pulverized coal to CO_2 gas prior to slurry preparation but that N_2 gas could be used as an inert blanket without deleterious results. The main device developed in this study was a sedimentation column based partly on measurements of subsidence, pycnometry and solvent extraction. The evidence supporting surfactant adsorption as the mechanism involved in the formation of the loosely flocculated network of a stabilized COM is discussed.

16456 **(NYSERDA—80-23) Coal-slurry test loop: development and operation.** (Adelphi Research Center, Inc., Garden City, NY (USA)). Feb 1980. 65p. New York State Energy Research and Development Authority, Albany.

This report describes a series of coal/oil mixture (COM) handling tests conducted at the Adelphi University Center for Energy Studies. The program was undertaken to evaluate the handling characteristics of COM under flow conditions similar to those found in a utility boiler feed system. Mixers, handling equipment, fittings, and mass flow meters were evaluated for use with COM. In order to measure the in-line viscosity of the COM, Poiseuille's equation was applied to flow loop measurement at the Adelphi University test loop and proved to be an excellent method of measuring coal concentrations. Viscosity values obtained in the test loop were compared with data from a concentric cylinder viscometer. Excellent agreement was obtained for 50% weight coal slurries. The viscosity of the COM is strongly dependent on oil viscosity, temperature, and coal concentration. A viscosity independent flow meter was tested and was shown to work well with COM. In addition, slurries with 30% coal by weight, with and without stabilizers, were evaluated in a pendulum settling device to measure the shift in their centers of mass versus settling time. All slurries exhibited rapid settling. An in-line and a batch mixer were successfully used to prepare the coal/oil slurries. No erosion was seen on the pipes, valves, or fittings of the test loop.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 16344, 16447, 17447

16457 **(DOE/PE—0027(Add.)) Coal competition: prospects for the 1980s.** (Department of Energy, Washington, DC (USA). Office of Competition). Mar 1981. 434p. NTIS, PC A19/MF A01.

This report consists of 10 chapters which present an historical overview of coal and the part it has played as an energy source in the economic growth of the United States from prior to World War II through 1978. Chapter titles are: definition of coals, coal mining; types of coal mines; mining methods; mining work force; development of coal; mine ownership; production; consumption; prices; exports; and imports. (DMC)

16458 **(EPRI-EA—1746) Coal industry problems. Final report.** Gordon, R.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Economics; Charles River Associates, Inc., Boston, MA (USA)). Mar 1981. 72p. NTIS, PC A04/MF A01.

This is a synthesis of information obtained from interviews with a number of coal industry executives. The discussions indicated the existence of considerable discontent about weak markets, excessive government regulation, and poor labor management relations. Great uncertainty existed about how these problems would be resolved. Estimates were obtained on current mining costs, but details were hard to obtain.

0160 Health And Safety

REFER ALSO TO CITATION(S) 16424, 16435, 16436, 16437, 16439, 16442, 17533

16459 **(NMAB—363) Measurement and control of respirable dust in mines.** (National Academy of Sciences - National Research Council, Washington, DC (USA). National Materials Advisory Board). 1980. 414p. National Academy of Sciences, Office of Publications, Washington, DC.

This committee report reviews past and current ways to measure respirable dusts that are injurious to the health of workers in mines. Also investigated were means of reducing airborne dust concentrations by improving methods used to mine coal and control dusts. Research and development gaps in the Bureau of Mines programs in these areas are identified and recommendations are made. Subjects considered include dust generation by fragmentation, mining machine design, dust measurement, dust characterization, dust suppression by ventilation, and deposition and retention of inhaled particles. Organizations with known capabilities to carry out the needed research projects are identified. (DMC)

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 16921

16460 **(DOE/ET/11268—6) Impact analysis of OSM regulations on highwall mining systems. Final report.** (Skelly and Loy, Harrisburg, PA (USA)). Sep 1980. Contract AC01-79ET11268. 173p. NTIS, PC A08/MF A01.

The establishment of the federal surface mining performance standards has placed additional restraints on auger mining. The federal regulations impose barrier pillar and hole sealing requirements on augering, stipulate time frames for hole sealing and discharge treatment, and prohibit auger mining under certain conditions. Barrier pillar requirements between groups of auger holes and between auger holes and underground workings decrease the augerable reserve base on a site by a minimum of ten percent. Barrier requirements may also reduce productivity levels due to increased delay and scheduling problems. Federal auger hole sealing requirements are more stringent than most state regulations, and consequently have increased the cost of augering in almost all auger mining areas. The availability of impervious materials on the site and the extent of backfilling required to form a water-tight seal may have the greatest effect on auger hole reclamation costs. The federal regulations require auger mining to be prohibited: if adverse water quality impacts cannot be prevented; if stability of sealings cannot be achieved; if subsidence resulting from augering may damage powerlines, pipelines, buildings, or other facilities; or if coal reserve recovery is not maximized by augering. As a result, all up dip augering may be restricted on the grounds that seal stability cannot be maintained for long time periods if water pressure builds behind the plug. Also, since tradiational augering techniques have a lower recovery rate than surface or underground methods, augering may be prohibited in many situations by the stipulation that maximum resource recovery will not be achieved.

16461 **(PB—80-207988) Black lung benefits program: selected references. Bibliography report, 1970-79.** (Department of Labor, Washington, DC (USA). Library). 1979. 36p. NTIS, PC A03/MF A01.

The bibliography contains references to publications related to the black lung benefits program that resulted from legislation passed in 1969 (the Federal Coal Mine Health and Safety Act of 1969), and amended subsequently in 1972 and 1977. References are limited primarily to the administrative, economic and social aspects of the program. The bibliography contains an 8-page listing of Congressional documents, in addition to the sections on books, magazine articles, etc.

16462 **Public's rulemaking role starts during earliest conceptual stages.** White, F.A. *Mine Safety and Health ;* **5**: No. 6, 16-20(Nov 1980).

An atmosphere of industry-government confrontation and largely in response to it, on March 24, 1978 - just two weeks after the 1977 Act became effective - President Carter issued Executive Order 12044, which required executive agencies of the Federal government to take certain steps in the development of their regulations in order to improve the regulatory process. Under the requirements of the executive order, agencies are to assure that: the need for and purpose of any regulation is clearly established; the regulation addresses the established need plainly, simply, and in a way that minimizes the burdens on the regulated population; meaningful alternative methods for meeting the need for the regulation are fully considered; and the public is provided with an early and effective opportunity to take part in the regulatory process. With the passage of the Federal Mine Safety and Health Act of 1977, which directed the newly created Mine Safety and Health Administration to develop and promulgate a number of important new rules, and in view of the changing regulatory climate, MSHA officials clearly recognized that the manner in which the agency developed its new requirements would to a large extent set the tone for its future relationship with the mining industry. It was necessary for MSHA to demonstrate in concrete terms that it would actively seek the advice and suggestions of industry and labor representatives and would be responsive to their concerns in its administration of the new law. From the beginning, the process of developing new regulations and standards, and the participation of industry and labor in that process, were critical elements in MSHA's overall goal of developing strong cooperative relationships with these groups.

02 PETROLEUM

0202 Geology And Exploration

16463 **(DOE/ET/12138—T2) Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report.** Negus-de Wys, J. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). Apr 1981. Contract AC21-76ET12138. 175p. NTIS, PC A08/MF A01.

This appendix contains strataspecific geochemical trend maps representing the contouring of data obtained by x-ray fluorescence and x-ray diffraction analyses of upper Devonian well cuttings from 14 wells in the Big Sandy Gas Field in Kentucky. (DMC)

16464 **(DOE/ET/12138—T3) Geochemistry studies in Eastern Kentucky. Final report.** Negus-de Wys, J. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). Apr 1981. Contract AC21-76ET12138. 216p. NTIS, PC A10/MF A01.

Presented here are the results of inorganic geochemical studies on well cuttings from fourteen wells in the Big Sandy Gas Field. Both x-ray fluorescence and x-ray diffraction were used in analysis. Resultant mineralic data and elemental data were mapped by computer and by hand for five intervals of Ohio Shale and for the Berea/Bedford sequence. Comparisons of the geochemistry trend maps were made with lithology, structure, thermal maturation, gas open flow, and paleoenvironment. Techniques used included visual map comparison, computer map comparison programs utilizing correlation coefficients based on grid derived data sets, cluster analysis, x-y plots, and r^2 (coefficient of determination). A limited number of regional maps are included. It is concluded that inorganic geochemical analysis can be useful in: (1) suggesting paleoenvironmental trends; (2) establishing depositional trends; (3) enhancing exploration in terms of setting limits and pinpointing potential areas for hydrocarbon recovery; and (4) identification of likely locations for large gas fields when used with other geological studies. Elemental data analysis is the most accurate, and can be done quickly and inexpensively. It is concluded that the Big Sandy gas field area is a unique stratigraphic-structural gas trap, in which sedimentary factors, depositional basin features, plant evolution and occurrence, and structural elements all played important roles. Combinations of certain of these ingredients in different amounts may exist in other parts of the basin, and thus, suggest areas for hydrocarbon accumulation and potential recovery.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 16895, 17242

16465 (CONF-810308—11) Aggregation of sodium alkylbenzenesulfonates in aqueous solution. Magid, L.J.; Shaver, R.J.; Gulari, E.; Bedwell, B.; Alkhafaji, S. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., TN (USA); Michigan Univ., Ann Arbor (USA)). 1981. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01.

From American Chemical Society symposium on the chemistry of engine combustion deposits; Atlanta, GA, USA (29 Mar 1981).

The surfactant 6 phenyl $C_{12}SNa$ forms small spherical micelles in aqueous solution, having an aggregation number of 20 to 30 and a fractional charge of 0.45. These micelles are hydrated to the extent of approximately 18 moles H_2O per moles of surfactant. A second larger aggregate is also present in 6 phenyl $C_{12}SNa$ solutions; its importance increases with solution age. Addition of NaCl causes both aggregates to apparently increase modestly in size. The surfactant 8 phenyl $C_{16}SNa$ also contains both aggregates in its solutions; the larger one is relatively more important here. The larger aggregate does not correspond to dispersed bits of a liquid crystalline mesophase.

16466 (CONF-8004140—) International Energy Agency workshop on enhanced oil recovery. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Feb 1981. 288p. NTIS, PC A13/MF A 01.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Twelve papers were presented at the International Energy Agency Workshop on enhanced oil recovery. These papers covered the areas of waterflooding which included carbon dioxide injection, role of surfactants, wettability studies of reservoir rock and porous materials, and vapor-liquid equilibrium studies of carbon dioxide and alkanes. Besides these papers, this Proceedings includes two papers, one on phase behavior of carbon dioxide and oil, and the other on microemulsion flooding.

16467 (CONF-8004140—, pp 1-19) **Wettability, the key to proper laboratory waterflooding experiments.** Hjelmeland, O.; Torsaeter, O. (SINTEF, Trondheim, Norway). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

The importance of wettability in displacement tests makes it necessary to take this parameter into consideration before such experiments are run. Most probably wettability of the core sample will be changed from the reservoir to the laboratory, and it is therefore recommended to restore the wettability. A procedure for restoration is proposed. Methods of measuring wettability have been studied, and two methods using reservoir rock samples are recommended. These methods are the capillary pressure test and the inhibition/displacement test. The contact angle measurement is proposed for research purposes, and this method can also be used at reservoir conditions.

16468 (CONF-8004140—, pp 20-23) **Measurement of contact angles at room and reservoir conditions.** Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

A high pressure optical cell has been applied in the experimental investigation of measuring contact angles of brine and oil. Experimental procedures are described for two series of measurements: one at room conditions using a dead crude oil from a North Sea reservoir, and the other at a constant temperature of 194°F (90°C) using a recombined oil from the same reservoir. The recombined sample measurements began at 5400 psi (372×10^5 Pa), and the pressure was lowered in steps of 145 psi (1×10^6 Pa) at constant temperature until bubble point was reached. The standard condition test showed two different contact angles. This is probably due to a heterogeneous surface of the quartz crystal. This problem will be tried and eliminated in the following measurements. The mean stabilized contact angle at room conditions was 65° and the contact angle at reservoir conditions was 21°. No changes of contact angles were observed in the pressure range down to bubble point. From the bubble point down to 2000 psi variations were found but due to the limited amount of data below the bubble point, and the scattering of these data, no conclusive statement can be suggested. The preliminary results show that the quartz crystal is more water-wetted under reservoir conditions than at standard conditions. For pressures above the bubble point no changes in the contact angle were observed when pressure was lowered.

16469 (CONF-8004140—, pp 25-40) **Determination of residual oil saturation in drilling project Maustrenk DF 1 by routine core analyses and relative permeabilities.** Schmied, H. (OMV Aktiengesellschaft, Vienna, Austria). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

In the case of the Maustrenk Reservoir the residual oil saturation (ROS) determined by routing core analyses and relative permeabilities were in good agreement with the results of well-logging and volumetric calculations. The advantage of this method is that one uses only data, which have to be measured in the laboratory always for the planning of a secondary or improved oil recovery project, and there is no additional work or costs. The disadvantages are: instead of a direct measurement one must use the empirical correlation function $M/(1 - V^2)$, where M = mobility ratio, and V = permeability variation; the ROS is only an average value for the total reservoir in the position of the well, and there is no information about the distribution of the ROS; one must core the reservoir from top to bottom without any loss; and the result is very sensitive to the number of M. This method gives only in special cases exact values for the ROS after a waterflooding. The values obtained with this method should be carefully checked and supported by additional methods.

16470 (CONF-8004140—, pp 41-70) **Measurement and correlation of conditions for entrapment and mobilization of residual oil.** Morrow, N.R.; Songkran, B. (Petroleum Recovery Research Center, Socorro, NM). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

A systematic study is being made of factors which affect the entrapment and mobilization of residual oil. The project has three main parts. The first deals with the entrapment and mobilization of residual oil, and the development and testing of capillary number (ratio of viscous to capillary forces) and Bond number (ratio of gravity to capillary forces) correlations. In the second part, specific aspects of wettability, namely, the magnitude of dynamic contact angles at rough surfaces, and the problem of accounting for wettability effects in capillary number and Bond number correlations are being investigated. The third part of the project concerns the magnitude and detailed structure of residual oil saturations and the application of capillary number studies to the correlation of in situ residual oil saturations determined close to the wellbore, where high pressure gradients can cause residual oil saturations to fall below their normal waterflood values. Progress to date is summarized. The mechanism of trapping is discussed and detailed results are presented of the effect of gravity and viscous forces on the magnitude of residual saturations trapped in unconsolidated porous media. For vertical displacement, residual saturations were correlated precisely using a linear combination of capillary number and Bond number. Residual saturations showed systematic change with angle of dip, but were less than those predicted by simply resolving gravity forces according to dip angle. The results imply that buoyancy forces can have a significant effect on microscopic displacement in low interfacial tension systems.

16471 (CONF-8004140—, pp 71-95) **Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface.** Novosad, J. (Petroleum Recovery Inst., Calgary, Alberta). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

This paper is concerned with the retention of surfactants considered for tertiary oil recovery in reservoir rocks. The first part includes a fundamental analysis of experimental variables which shows that a maximum in the surfactant adsorption isotherm should be expected. Advantages and disadvantages of using experi-

mental variables such as surface excess, amount adsorbed and selectivity are discussed and the relationships among these are developed. For example, it is shown that selectivity is the most suitable variable for extrapolation of experimental data. The second part discusses the adsorption of surfactant mixtures. Difficulties in analyzing experimental data are pointed out and a method for determining adsorption of surfactant mixtures from the data on adsorption of individual surfactants is suggested. Calculations showing that the overall isotherm may be quite different from the isotherms of individual surfactants are performed. The third part is concerned with solubilities of surfactants in brines in a presence of alcohol cosurfactants. Experimental data presented indicate that quite large amounts of alcohol are needed to keep surfactants fully dissolved in brine solutons. The fourth part includes experimental results on adsorption of pure surfactant and petroleum sulfonates on Berea sandstone. Retention of surfactants is related to their solubility limits in the brine.

16472 (CONF-8004140—, pp 105-115) **Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs.** Neumann, H.J. (Inst. for Petroleum Research, Hannover, West Germany); Behrmann, R.B. Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Glass, quartz, mica and silan glass were used to similate a porous sandstone reservoir rock, and carboxymethylized oxyethylate, naphthenic acid betaine, and alkylsulfonate were the surfactants used in the wettability-tension experiments. The results of the experiment point to the following specifications for selection of surfactants for chemical flooding purposes: (1) the minimum of the interfacial tension should occur in the low concentration range of the surfactant; (2) the interfacial tension should rise slowly after having passed the minimum value; (3) the surfactants dissolved in the flood-water should be able to partition between the oil and water phase in o/w and w/o emulsion and in a third microemulsion phase as well; (4) the phase-inversion temperature should be close to the reservoir temperature; and (5) the surfactants should equalize the wettability-tension of the oil-phase with that of the water-phase, whenever possible. Future work will be mostly devoted to requirement 3. A great deal of experimental work is necessary for designing field tests for surfactant-flooding. The experimental results so far have shown that the formation of a micro-emulsion phase - at least in the cast of the systems with high-saline waters - is a must for the residual oil mobilization. Most likely for this very purpose high concentrated surfactant-slugs (2. . . 5%) are required. For the sake of future rentability it is also imperative to investigate the minimum required surfactant concentration, without losing the flood efficiency. This problem is a part of the research work for the determination of the critical limits of dimensionless quotients of displacement and retaining forces.

16473 (CONF-8004140—, pp 116-143) **Towards understanding wettability effects on oil recovery.** Batycky, J.P. (Petroleum Recovery Inst., Calgary, Alberta). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Studies of oil recovery have largely dealt with immiscible displacement of oil from strongly wetting and, in particular, from strongly water-wetting parameters. While their various interpretations differ on specifics, there is unanimity in the fact that viscous forces (and to a minor extent gravity forces) lead to oil mobilization and that capillary forces cause trapping and isolation of oil droplets. Using the interpretation of mobilization, two extremes in pore geometry can lead to two different types of recovery behavior at near-intermediate wettability conditions. If the grains are well cemented, then movement of oil ganglia occurs by tangential displacement along the near capillary-shaped pore. However, if there are protrusions into the pore body or if the walls of the porous medium are irregular and the oil wets the solid to some extent, then, mobilization is hindered by the necessity to cause detachment of the advancing (rear) portions of the ganglion. This scenario is applicable also to salt-and-pepper mixed wettability systems which are likely quite common because of the heterogeneous minerology along the pore surfaces. It can also be suggested that, in addition to trapping and snap-off at pore throats, break-up of ganglia by adhesion to the solid can also create residuals that are not amenable to high capillary number displacement. The information of composite surfaces due to the presence of surface roughness would tend to reduce mobilization difficulty.

16474 (CONF-8004140—, pp 145-165) **Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins.** Nagahama, K. (Tokyo Metropolitan Univ., Japan). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

The objectives for this study are to collect all of the available vapor-liquid equilibria (VLE) data for the binary systems containing CO_2, C_1, and C_{10} paraffins which are of interest in CO_2 flooding, and to evaluate each set of binary data for thermodynamic consistency based on a method developed by Van Ness et al, [AIChE J. 19, 328(1973)]. About two-thirds of the VLE data set for CO_2 systems appears to satisfy a screening criterion which is determined empirically. The modified Redlich-Kwong equation, the Soave-Redlich-Kwong equation and the Peng-Robinson equation have the same capabilities for making VLE calculations below the critical region. Those equations, however, can not predict the phase equilibrium in the region close to the critical. The inadequacy of equations is a very significant problem when attempting to precisely simulate the CO_2 flood mechanism. 55 references.

16475 (CONF-8004140—, pp 166-183) **Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide.** Sayegh, S.G. (Petroleum Recovery Inst., Calgary Alberta). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Mixtures of carbon dioxide with sulfur dioxide have the potential of being efficient miscible oil recovery agents. To investigate this possibility, phase equilibrium and physical property measurements were carried out for such mixtures with methane, n-pentane, and n-hexadecane representing crude oils.

16476 (CONF-8004140—, pp 184-202) **Weeks Island S Sand Reservoir B gravity stable tertiary CO_2 displacement, Iberia Parish, Louisiana.** Perry, G.E.; Kidwell, C.M. (Shell Oil Co., New Orleans, LA). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Shell, in conjunction with the Department of Energy is conducting a gravity stabie displacement field test of the miscible CO_2 process. The test is being conducted in a 12,800-ft-deep Gulf Coast reservoir. Injection of the CO_2 slug at the producing gas-oil contact commenced in October 1978. The slug of CO_2 is being moved downward by production of downdip water. Injection of the 50,000-ton slug was completed in February of 1980, and production is projected to start in mid-1980. Conventional cores and the log-inject-log technique were used to determine residual oil saturation in a well drilled as the pilot producer. The new well is being used to monitor the downdip displacement. Pulsed neutron logging devices have been used to monitor the CO_2 movement in the vicinity of the observation well. The logs have been successful in detecting CO_2 and its subsequent movement. Production tests of the log-inject-log perforations, located in a previously watered-out portion of the sand, 48 feet below the point of CO_2 injection in the offset well, have indicated an oil column has passed the observation perforations in November, 1979. These perforations were then squeezed off in preparation for completing the well 130 feet below the level of CO_2 injection.

16477 (CONF-8004140—, pp 203-225) **Evaluation of the potential for EOR using CO_2 in North Sea reservoirs.** Fayers, F.J.; Hawes, R.I. (Atomic Energy Establishment, Winfrith, England). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

This paper reviews the progress made during the early stages of a program of research to evaluate the feasibility of utilizing CO_2 or flue gas as an EOR method in North Sea reservoirs. The paper describes the status of equation of state calculations for determining multi-contact miscibility and reviews the first results of CO_2-displacement calculations using a compositional reservoir sim-

ulator. The final section deals with some aspects of the supply of CO_2 from power stations located in Scotland.

16478 (CONF-8004140—, pp 227-242) **Phase behavior of CO_2 and crude oil in low temperature reservoirs.** Orr, F.M. Jr.; Yu, A.D.; Lien, C.L. (New Mexico Petroleum Recovery Research Center, Socorro). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Phase behavior of carbon dioxide-crude oil mixtures which exhibit liquid-liquid and liquid-liquid-vapor equilibria is examined. Results of single contact phase behavior experiments for CO_2 separator oil mixtures are reported. Experimental results are interpreted using pseudo-ternary phase diagrams based on a review of phase behavior data for binary and ternary mixtures of CO_2 with alkanes. Implications for the displacement process of liquid-liquid-vapor phase behavior are examined using a one-dimensional finite difference simulator. Results of the analysis suggest that liquid-liquid and liquid-liquid-vapor equilibria will occur for CO_2-crude oil mixtures at temperatures below about 50°C (122°F), and that development of miscibility occurs by extraction of hydrocarbons from the oil into a CO_2 rich liquid phase in such systems.

16479 (CONF-8004140—, pp 243-279) **Micellar-polymer oil recovery demonstration in the Bell Creek Field, Montana.** Goldburg, A.; Stevens, P. (Gary Energy Corp., Englewood, CO). Feb 1981.

From International Energy Agency workshop on enhanced oil recovery; Bartlesville, OK, USA (24 Apr 1980).

Gary Energy Corporation is conducting a DOE Demonstration Pilot to determine whether micellar-polymer waterflooding is an economically feasible technique for enhanced oil recovery at the Bell Creek Field, Powder River County, in southeastern Montana. The pilot is a contained 40-acre 5-spot embedded in a representative water-out portion of the field. The net pay is sandstone with average properties: thickness, 6.4 feet; porosity, 25%; permeability (air) 1050 md; and water TDS of 4000 ppM. The pilot area interwell oil saturation after waterflood available for tertiary recovery is presently evaluated at 28%; and the overall micellar-polymer recovery is estimated at 47%. During the past year site development continued and included: conclusion of the radioactive tracer survey, completion of the Bell Creek core analysis by Core Laboratories, injection well shut-in and two-rate tests to determine the probable well MP-3, completion of the simulation work by Intercomp for the three major phases of the project, and continued production monitoring. Preflush and the Soluble Oil/Micellar Water injection was initiated and completed and the polymer mobility buffer injection is now in progress. The other major effort for the year was the field experimentation to achieve an optimal oxygen scavenging program to protect the graded polymer bank from viscosity degradation.

16480 (DOE/BC/10069—10) **Mechanism of oil bank formation, coalescence in porous media and emulsion stability. Annual report, June 1979-May 1980.** Wasan, D.T. (Illinois Inst. of Tech., Chicago (USA)). Feb 1981. Contract AC19-79BC10069. 225p. NTIS, PC A10/MF A01.

This report presents results of a basic study of coalescence phenomena, emulsion formation and stability, and dynamic interfacial properties when crude oils and pure hydrocarbons are contacted with aqueous solutions of surfactant/polymer and alkaline agents. These measurements are correlated with each other and with observations on oil bank formation and displacement and recovery efficiency by chemical flooding in microwave monitored laboratory core flooding experiments. The scope of this work includes three interrelated tasks: I - Caustic Flooding of Heavy Crude, II - Surfactant/Polymer Flooding, and III - Thin Liquid Films: drainage and stability of foam and emulsion films. Results obtained in each of these three tasks are summarized: Crude oils from Huntington Beach, Wilmington Field, Salem and El Dorado and the hydrocarbon, decane were used. The chemical agents employed were: n-hexanol, Dow Pusher 700, sodium lauryl sulfate, lauryl alcohol, petroleum sulfonate, TRS 10-80, TRS 10-410, iBuOH, NaCl brine, sodium orthosilicate, sodium hydroxide, Petrostep 465, and C_3 to C_8 alcohols.

16481 (DOE/BETC—80/4) **Progress review No. 24: contracts for field projects and supporting research on enhanced oil recovery and improved drilling technology. Progress report, quarter ending September 30, 1980.** Linville, B. (ed.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Feb 1981. 185p. NTIS, PC A09/MF A01.

Reports are presented of contracts for field projects and supporting research on chemical flooding, carbon dioxide injection and thermal/heavy oil, as well as for the following areas of research: extraction technology; resource assessment technology; environmental; petroleum technology; microbial enhanced oil recovery; improved drilling technology; and general supporting research.

16482 (DOE/ET/12047—52(Vol.1)) **Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 1. Body of report.** Carmichael, J.D. (Long Beach City Dept. of Oil Properties, CA (USA); THUMS Long Beach Co., CA (USA)). Mar 1981. Contract AC03-76ET12047. 108p. NTIS, PC A06/MF A01.

Comparative core flood testing of preserved Ranger Zone core rock samples was completed; the past year's results were discouraging. In contrast, Ranger sand pack alkaline flood tests gave encouraging results. New insights were gained on in-situ alkaline consumption. Dehydration of sodium orthosilicate water-produced water-crude oil systems does not appear to create any operational problems. The alkaline injection facilities were completed and placed in operation on March 27, 1980. The preflush injection, which was composed of 11.5 million barrels of softened fresh water with an average 0.96% of salt, was completed at that time. The total preflush amounted to approximately 10 pore volume percent. The 0.4% sodium orthosilicate-1.0% salt-soft fresh water injection started at the end of the preflush. A loss of injectivity began at the same time as alkaline injection, which is attributed to divalent ions in the salt brine. Salt was removed temporarily from the system on May 30, 1980. No injection wells were redrilled during the year. Other than plug back of one injector and one producer because of bad liners and repair of one injection well with an inner liner, well work was routine and minor in nature. Dual injection strings were transferred from one well to another. One of the injection wells whose injectivity was damaged by the alkaline-salt injection was successfully stimulated. The pilot was self certified under the tertiary incentive program and cost recoupments obtained. Preparations are underway for making the alkaline flood simulator performance prediction for the pilot. Laboratory testing is actively underway in an attempt to quickly find a remedy for the floc formation that occurs on mixing the salt brine and dilute alkaline solution. Volume 1 describes the activities for this period. Volumes 2 and 3 contain appendices.

16483 (DOE/ET/12047—52(Vol.2)) **Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 2. Appendix I.** Carmichael, J.D. (Long Beach City Dept. of Oil Properties, CA (USA); THUMS Long Beach Co., CA (USA)). Mar 1981. Contract AC03-76ET12047. 466p. NTIS, PC A20/MF A01.

This appendix to the 1979-1980 annual report contains basic laboratory test reports, detailed instructions, plans and procedures, and various calculated data derived from operating observations. These are considered to be of sufficient interest to warrant their publication, but because of their bulk, to be of too much detail for inclusion in the body of the report. The table of contents specifies each group of data or description as a section which is believed to be complete in itself. The order of inclusion of the various sections has been dictated by the sequence of their reference in the body of the 1979-1980 annual report.

16484 (DOE/ET/12047—52(Vol.3)) **Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 3. Appendices II-XVII.** Carmichael, J.D. (Long Beach City Dept. of Oil Properties, CA (USA); THUMS Long Beach Co., CA (USA)). Mar 1981. Contract AC03-76ET12047. 328p. NTIS, PC A15/MF A01.

Volume 3 contains Appendices II through XVII: mixing instructions for sodium orthosilicate; oil displacement studies using THUMS C-331 crude oil and extracted reservoir core material from well B-110; clay mineral analysis of B-827-A cores; sieve analysis of 4 Fo sand samples from B-110-IA and 4 Fo sand samples from B-827-A; core record; delayed secondary caustic consumption tests; long-term alkaline consumption in reservoir sands; demulsification study for THUMS Long Beach Company, Island White; operating plans and instructions for DOE injection demonstration project, alkaline injection; caustic pilot-produced water test graphs; well test irregularities (6/1/79-5/31/80); alkaline flood pump changes (6/1/79-5/31/80); monthly DOE pilot chemical waterflood injection reports (preflush injection, alkaline-salt injection, and alkaline injection without salt); and caustic safety procedures-alkaline chemicals.

16485 **(DOE/ET/12056—20) Estimation of oil recovery by in-situ combustion in the Jobo Field of Eastern Venezuela.** Luengo-C, J.R.; Sanyal, S.K. (Stanford Univ., CA (USA). Petroleum Research Inst.). Mar 1981. Contract AC03-76ET12056. 37p. NTIS, PC A03/MF A01.

A laboratory combustion experiment using samples from Jobo Field was completed. The data obtained by this experiment could be used for an approximate estimation of recovery for a pilot project in this field. An isolated pilot test would give enough information to determine the behavior of the combustion process for field applications. Aplication of recovery correlations indicate that a pilot test in an inverted 5-spot pattern (10 to 20 acres spacing) appears adequate for these field conditions. Air injection rates should be calculated and compared with injectivity tests, the ability of the producing wells to handle the oil, and the maximum pressure the reservoir can handle without fracturing.

16486 **(DOE/ET/12075—2) Scaled physical model studies of the steam drive process. Second annual report, September 1978-September 1979.** Dosher, T.M. (University of Southern California, Los Angeles (USA). Dept. of Petroleum Engineering). Feb 1981. Contract AT03-76ET12075. 82p. NTIS, PC A05/MF A01.

A scaled physical model was operated to simulate steam drive operations in five-spot patterns with reservoir and operational parameters similar to those encountered in California reservoirs. The goal of this study was to elucidate the role of two important controllable parameters, viz., steam injection rate and steam quality and to explore the role of two important factors, oil viscosity and reservoir permeability on the performance of the steam drive. In addition, the influence of bottom water and a basal permeable layer were investigated. The experiments demonstrated that there is an optimum injection rate; that in the vicinity of this optimum an increased quantity results in improved oil steam ratios; that the viscosity of the oil at steam temperature, raised to a fractional power, 0.5, appears to correlate with oil production; that permeabilities in the darcy range have little effect on performance, but an increasing one with low viscosity oil, and that bottom water, which facilitates injection, results in toorer early performance but one which eventually rivals the oil/steam ratio of a uniform reservoir at a somewhat higher recovery of original oil in place. It has been concluded that the major value of the physical model is in describing the role of the reservoir and operational parameters of a class of steam drive operations rather than providing an exact prediction of a given operation.The problem of supplying the latter lies in the virtually impossible-to-define distribution of oil, gas and water in the reservoir on initiating the steam drive. Two years of this project have now been completed. During the forthcoming final phase of the program, effort will be devoted to studying the relative effects of solvent and gas addition to the steam, of diurnal injection, and of (horizontal) well placement.

16487 **(DOE/ET/14317—T2(Vol.1)) Review of technology for Arctic offshore oil and gas recovery.** Sackinger, W.M. (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Aug 1980. Contract AC01-80ET14317. 105p. NTIS, PC A06/MF A01.

The technical background briefing report is the first step in the preparation of a plan for engineering research oriented toward Arctic offshore oil and gas recovery. A five-year leasing schedule for the ice-prone waters of the Arctic offshore is presented, which also shows the projected dates of the lease sale for each area. The estimated peak production rates for these areas are given. There is considerable uncertainty for all these production estimates, since no exploratory drilling has yet taken place. A flow chart is presented which relates the special Arctic factors, such as ice and permafrost, to the normal petroleum production sequence. Some highlights from the chart and from the technical review are: (1) in many Arctic offshore locations the movement of sea ice causes major lateral forces on offshore structures, which are much greater than wave forces; (2) spray ice buildup on structures, ships and aircraft will be considerable, and must be prevented or accommodated with special designs; (3) the time available for summer exploratory drilling, and for deployment of permanent production structures, is limited by the return of the pack ice. This time may be extended by ice-breaking vessels in some cases; (4) during production, icebreaking workboats will service the offshore platforms in most areas throughout the year; (5) transportation of petroleum by icebreaking tankers from offshore tanker loading points is a highly probable situation, except in the Alaskan Beaufort; and (6) Arctic pipelines must contend with permafrost, making instrumentation necessary to detect subtle changes of the pipe before rupture occurs.

16488 **(DOE/MC/10689—5) Development of mobility control methods to improve oil recovery by CO_2. First annual report, October 1, 1979-September 30, 1980.** Heller, J.P.; Taber, J.J. (New Mexico Inst. of Mining and Technology, Socorro (USA)). Mar 1981. Contract AC21-79MC10689. 33p. NTIS, PC A03/MF A01.

Phase 1 of this project was completed in July 1980 with the publication of the report Mobility Control for CO_2 Floods - A Literature Survey. The report's topics include the fundamental mechanisms of displacement and displacement instability in porous media, field tests and laboratory experiments on CO_2 flooding, and the methods which have been proposed to alleviate the low sweep efficiency caused by unfavorable mobility ratio. These suggested methods have been grouped, into three categories of mobility control procedures. They all involve the reduction of the displacing fluid mobility. The first of the three methods is called Water Alternated with Gas, or WAG for short. A second method which has been proposed for mobility control is the use of foam - a dispersion of gas or solvent in water. Several early studies demonstrated the marked increase in flow resistance when the rock contained such a surfactant-stabilized dispersion. The third proposed mobility control method is the use of thickeners. Existing literature on this method has been concerned with the use of polymers which, when dissolved at low concentration in brine, are able to greatly increase its viscosity. Activity on Phase 2 - experimental design, and laboratory work - was initiated early in the life of the project and has accelerated steadily. A suitable dolomite rock saple has been obtained and cut to shape, a high pressure core holder has been designed and constructed, and preliminary tests made on a foam generation method. In addition to the work outlined above on Phases 1 and 2 some time has also been devoted to the consideration of Phase 3 - the available methods for optimum mobility control in enhanced oil recovery projects using CO_2.

16489 **(NP—25370) Displacement of oil by carbon dioxide.** Orr, F.M. Jr.; Taber, J.J. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Mar 1981. 166p. (EMD—2-68-3304). New Mexico Energy and Minerals Department, Santa Fe.

Results of displacements of crude oil from slim tubes, cores and mixing cells are presented and interpreted in terms of detailed measurements of the phase behavior and fluid properties of the CO_2-crude oil mixtures. A simple one-dimensional process simulator for CO_2 flooding applications is described. Good agreement is reported between calculated and experimental results as long as the volume change of CO_2 on mixing with the oil is not too great. Sensitivity of calculated results to phase behavior and fluid properties is discussed. There is evidence that the high displacement efficiency which can be obtained when pressure is high enough and viscous fingering is controlled is the result of efficient extraction of a broad range of hydrocarbons by a dense CO_2-rich phase which is a liquid if the temperature is below about 50°C (130°F). Factors such as

phase behavior, viscous fingering, gravity segregation and core heterogeneity influencing laboratory experiments are reviewed.

0204 Processing

16490 (CONF-800483—(Vol.2), pp 799-804) **Role of the FLEXICOKING process in heavy-oil processing.** Taylor, R.I. (Exxon Tech., Houston, TX). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The recently commercialized FLEXICOKING Process has a significant role to play in developing known heavy-oil reserves. The process upgrades virtually any pumpable feed including residual, pitch, or total crude. Combined with HYDROFINING, it produces a clean product slate composed of low Btu gas, high-Btu gas, LPG, naphtha, distillate, and gas oil. The low-Btu gas falls within the definition of an Alternate Fuel under current legislation. Originally developed for refinery-bottoms conversion, the FLEXICOKING process can also be used as the primary technology for Stand Alone Energy Centers upgrading low-quality, high metals, heavy crudes. These efficient energy centers can be located either at a heavy-oil production field or integrated with an energy-intensive industrial complex.

16491 **Effect of H_2S on the hydrogenation and cracking of hexene over a CoMo catalyst.** Ramachandran, R.; Massoth, F.E. (Univ. of Utah, Salt Lake City). Contract E(49-18)-2006. *Journal of Catalysis ;* 67: No. 1, 248-249(Jan 1981).

Results show that H_2S has no effect on the hydrogenation function and increases the cracking function of sulfided CoMo catalysts. Since H_2S depresses the hydrogenolysis function, it appears that these three reactions occur on different active sites.

0205 Products And By-products

REFER ALSO TO CITATION(S) 16490

0206 Health And Safety

REFER ALSO TO CITATION(S) 17452

0207 Marketing And Economics

16492 (PB—80-210289) **Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report.** Waring, K.; Smythe, T.J.; Schultheis, M.C. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Mar 1980. Contract DI-AA550-CT6-61. 333p. NTIS, PC A15/MF A01.

The two-volume report projects and analyzes how the proposed Lower Cook Inlet OCS Lease Sale No. 60 might affect the growth and community infrastructure of the cities of Kenai, Soldotna, and Homer, Alaska. Volume One is a baseline description of existing population and economic conditions in the Kenai Peninsula Borough and the cities of Kenai, Soldotna, and Homer. This volume also presents baseline data for each city, describing current land use patterns, land tenure and housing conditions, public utilities (water, sewer, power, solid waste, communications), police and fire protection, health and social services, education, recreation, and local governmental powers and finances.

16493 (PB—80-210297) **Alaska OCS socioeconomic studies program. Technical report number 46. Volume 2. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report.** Waring, K.; Smythe, T.J.; Schultheis, M.C. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Mar 1980. Contract DI-AA550-CT6-61. 462p. NTIS, PC A20/MF A01.

This two-volume report projects and analyzes how the proposed Lower Cook Inlet OCS Lease Sale No. 60 might affect the growth and community infrastructure of the cities of Kenai, Soldotna, and Homer, Alaska. Volume Two presents growth impact forecasts developed for a base case (without OCS Sale No. 60) and for three (low, mean, high) hypothetical petroleum development scenarios. In the growth impact analysis, particular attention is given to the potential impacts on the specific community facilities and services described in the baseline volume.

16494 (PB—80-212467) **Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report.** Eakland, P.B.; Joshi, R. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Apr 1980. Contract DI-AA550-CT6-61. 391p. NTIS, PC A17/MF A01.

The purpose of the report is to assess the impacts of a range of oil and gas development activities from Outer Continental Shelf Lease Sale No. 55 in the Northern Gulf of Alaska on statewide, regional, and local transportation systems. The analysis focuses on the communities of Seward, Cordova, and Yakutat and on the Anchorage metropolitan region. Additional communities in the eastern Gulf of Alaska, which have important transportation facilities, specifically Valdez and Whittier, have been included. The introductory chapter describes the scope of the study, explains how it relates to other studies in the Socioeconomic Studies Program, and summarizes the methodology. Chapter 2 describes the existing conditions for transportation facilities and services by region. Chapter 3 presents the transportation demand forecasts and impact assessments for a range of conditions without Lease Sale No. 55. Chapter 4 presents an analysis of five cases having a range of economic discoveries of oil and gas in the Yakutat, Middleton, and Yakataga Shelves. Most of the discoveries are assumed to be in the Yakutat Shelf. Requirements for direct OCS facilities, such as berths for supply boats, are established and demands are established for movements of OCS tonnage and movements of OCS employees.

16495 (PB—80-212475) **Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report.** Terry, J.M.; Scoles, R.G.; Larson, D.M. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Jul 1980. Contract DI-AA550-CT6-61. 547p. NTIS, PC A23/MF A01.

The objectives of the report are to increase the understanding of the potential relationships between the commercial fishing and Outer Continental Shelf (OCS) petroleum industries and to project the potential impacts on the commercial fishing industry of Cook Inlet and Shelikof Strait that may occur as a result of the proposed OCS Lease Sale Number 60. To meet this objective, the report consists of: (1) the documentation and examination of the history and current trends of the Cook Inlet and Shelikof Strait commercial fishing industry as necessary to develop a basis for projecting fishery development and potential interactions with the OCS petroleum industry, (2) the development of models used to forecast the level of commercial fishing industry activity through the year 2000 in the absence of OCS development pursuant to Lease Sale Number 60, and (3) an analysis of the potential impacts of Lease Sale Number 60 based on the hypothesized nature and magnitude of the activities of the commercial fishing and OCS petroleum industries. Both the harvesting and processing sectors of the fishing industry are considered. The sources of impacts considered are the competition for labor, ocean space use, and the infrastructure. Potential impacts due to environmental or biological changes resulting from OCS petroleum development are not considered.

16496 (PB—80-212624) **Alaska OCS socioeconomic studies program. Technical report number 31. Bering-Norton petroleum development scenarios local socioeconomic systems analysis. Final report.** Ender, R.L.; Gorski, S.E.; Harrison, G.; Braund, S. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). 1 Jul 1980. Contract DI-AA550-CT6-61. 620p. NTIS, PC A99/MF A01.

The document provides a baseline profile of the communities of Nome and Kotzebue encompassing local socioeconomic conditions; and an impacts analysis of Nome, Alaska with and without the proposed oil lease sale scheduled for Norton Sound. Topics include an historical perspective, a comprehensive discussion of the

local economic conditions and current demographic information; local government revenues and expenditures and community support service sectors including health and social services, leisure, education, public safety, utilities, land use and housing. Socioeconomic impacts are defined with three different growth scenarios stemming from oil development and are compared to a non-OCS base case which defines impacts of growth without the presence of oil development. A final section includes a comprehensive discussion of the assumptions, methods and standards, used in the assessment of impacts due to growth in population employment and service sectors in Nome, Alaska.

16497 **(PB—80-222482) Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report.** Porter, E.D. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Jun 1980. Contract DI-AA550-CT6-61. 188p. NTIS, PC A09/MF A01.

The study describes the economic and demographic effect of OCS development on the Bering-Norton lease sale. The report describes a base case growth and the changes which result for the state, region, and Nome Census Division.

0208 Waste Management

REFER ALSO TO CITATION(S) 17388

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 17363, 17364, 17437, 17438, 17455

16498 **(DOE/EV/04548—1) Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981.** Chang, H.R.; Reid, R.C. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). Apr 1981. Contract AS02-77EV04548. 38p. NTIS, PC A03/MF A01.

An experimental and theoretical investigation was carried out to study the boiling and spreading of liquid nitrogen, liquid methane and liquefied petroleum gas (LPG) on water in a one-dimensional configuration. Primary emphasis was placed on the LPG studies. Experimental work involved the design and construction of a spill/spread/boil apparatus which permitted the measurement of spreading and local boil-off rates. With the equations of continuity and momentum transfer, a mathematical model was developed to describe the boiling-spreading phenomena of cryogens spilled on water. The model accounted for a decrease in the density of the cryogenic liquid due to bubble formation. The boiling and spreading rates of LPG were found to be the same as those of pure propane. An LPG spill was characterized by the very rapid and violent boiling initially and highly irregular ice formation on the water surface. The measured local boil-off rates of LPG agreed reasonably well with theoretical predictions from a moving boundary heat transfer model. The spreading velocity of an LPG spill was found to be constant and determined by the size of the distributor opening. The maximum spreading distance was found to be unaffected by the spilling rate. These observations can be explained by assuming that the ice formation on the water surface controls the spreading of LPG spills. While the mathematical model did not predict the spreading front adequately, it predicted the maximum spreading distance reasonably well.

16499 **(DOE/EV/24047—03) Assessment of treated vs untreated oil spills. Final report.** Wilson, M.P. (Rhode Island Univ., Kingston (USA). University Energy Center). Feb 1981. Contract AS02-76EV04047. 1048p. NTIS, PC A99/MF A01.

The results of a series of studies conducted to determine the practicability and feasibility of using dispersants to mitigate the impact of an oil spill on the environment are described. The method of approach is holistic in that it combines the physical, chemical, microbial and macro-fauna response to a spill treated with dispersants and compares this with spills that are left untreated. The program integrates mathematical, laboratory, meso-scale (three 20 foot high by three feet in diameter tanks, in-situ experiments and analyses to determine if the use of dispersants is an effective oil spill control agent. In summary, it appears viable to use dispersants as determined on a case by case basis. The case for using dispersants has to be based on whether or not their use will mitigate the environmental impact of the spill. In the case of an open ocean spill that is being driven into a rich inter-tidal community, the use of dispersants could greatly reduce the environmental impact. Even in the highly productive George's Bank area at the height of the cod spawning season, the impact of the use of dispersants is well within the limits of natural variability when the threshold toxicity level is assumed to be as low as 100 ppB, a level which is often found in the open ocean. Thus, it appears that dispersants can and should be used when it is evident that their use will mitigate the impacts of the spill. Their use in areas where there is poor circulation and therefore little possibility of rapid dilution is more questionable and should be a subject of future studies.

16500 **(NP—25371) Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69.** (Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office). Mar 1981. 434p. NTIS.

Proposed OCS Sales 67 and 69 are scheduled for March and August 1982, respectively, in accordance with the Department of the Interior's Final 5-Year OCS Oil and Gas Leasing Schedule (June 1980). This EIS covers both sales due to the geographical and chronological proximity of the sales to each other. Lease offerings under consideration consist of 2,458,827 acres (472 tracts) offshore the states of Texas, Louisiana, Mississippi, Alabama, and Florida. The tracts vary from 3 to 140 nautical miles from shore in water depths from 2 to 2400 meters. In the area of cumulative transportation impacts, it is assumed that gas or oil production offshore Texas or Louisiana, respectively, could contribute to construction of a new gas trunk pipeline with landfall along the Texas coast or construction of one or more additional oil trunk pipelines with landfall along the Louisiana coast. Production at the Upper Gulf area could contribute to eventual construction of a new trunk pipeline with landfall in Mississippi or Alabama, and production on the Florida Shelf could contribute to construction of a new trunk pipeline with landfall along the west coast of Florida. Further, it is assumed that existing onshore facilities will be used with little or no expansion attributable to the proposed sales. Tracts offshore Texas and Louisiana will utilize existing service bases in Texas and Louisiana, respectively, and tracts at the Florida Shelf will use existing or expanded Port Manatee facilities. Tracts in the Upper Gulf area will use existing, expanded, or new service base facilities in Jackson County, Mississippi and/or Mobile County, Alabama. Environmental impacts in the following areas have been investigated: risk of oil spill; biologically sensitive areas; Florida Manatee; recreational fishing; coastal and marine birds; and cumulative impacts. Socio-economic factors are also addressed. (DMC)

16501 **(PB—80-220593) Assessment of land treatment technology for petroleum refinery solid wastes.** Pal, D.; Overcash, M.R. (North Carolina Water Resources Research Inst., Raleigh (USA)). Jul 1980. Contract DI-14-34-0001-7173. 42p. NTIS, PC A03/MF A01.

The report examines land treatment for the aggregate refinery solid wastes using representative constituent characteristics and site conditions. A major distinction is drawn between existing petroleum industry land farming and the site nondegradation approach of land treatment used in this report. The latter is more closely linked to the RCRA approach to hazardous waste management. The results of this study do not represent design criteria because of the highly critical need to test individual wastes and sites to be used before specification or permit approval of such systems. In addition to the evaluation of land treatment as an option for these total refinery solid wastes, a fundamental design procedure is presented. This procedure demonstrates the detailed levels of soil and waste analyses required to design any land application system. Successful long term performance and adherence to soil, food-chain, groundwater nondegradation constraints depend on utilizing an in-depth design procedure. Results of this study have demonstrated the differences attributable to soils, the waste parameters which are critical in design, and the potential savings associated with in-plant source control.

16502 **(PB—80-221039) Demonstration of carbon adsorption technology for petroleum dry cleaning plants. Final report, October 1977-April 1979.** Lutz, S.J.; Mulligan, S.W.; Nunn, A.B. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Jun 1980. Contract EPA-68-03-2560. 98p. NTIS, PC A05/MF A01.

A carbon adsorption system was designed and installed on the exhaust outlet from a dryer at an industrial dry cleaning plant utilizing Stoddard solvent for cleaning purposes. Selected design and operating parameters were varied to determine their effect on annualized operating costs and system performance. After optimization, the carbon adsorber achieved a demonstrated efficiency in reducing hydrocarbon emissions of 95 percent.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 16922, 17389

16503 **(PB—80-210271) Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report.** Eakland, P.; Joshi, R. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). Mar 1980. Contract DI-AA550-CT6-61. 368p. NTIS, PC A16/MF A01.

The Socioeconomic Studies Program, of which this report is a part, is a multi-disciplinary effort designed to assess the range of local, regional, and statewide impacts that might occur if oil and gas activities took place in the outer continental shelf (OCS). The purpose of this report is to assess the cumulative and incremental transportation impacts resulting from activities related to Lease Sale No. 60, which includes areas in Lower Cook Inlet and Shelikof Strait. Anchorage and Southcentral Alaska are the focus of the regional analysis for transportation systems. The community analysis focuses on Kenai and Homer. The report has four chapters. The introductory chapter provides an overview of the report and discusses the nature of transportation impacts. Chapter 2 contains a description of existing facilities and services for the water, air, and land modes. This information provides baseline conditions that are used to forecast transportation demands and impacts during the study period (1982-2001). Chapter 3 presents transportation demands and resulting impacts for the base case, which includes the moderate scenario of Lease Sale No. CI in the Lower Cook Inlet and of other previous lease sales. Chapter 4 presents the demands and impacts of the three OCS cases. These cases are based on the low, moderate, and high petroleum development scenarios for the lease sale. Emphasis is placed on analysis of the moderate case, since it is the most likely to occur.

16504 **(PB—80-219264) Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report.** Ellanna, L.J. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA)). 30 Apr 1980. Contract DI-AA550-CT6-61. 469p. NTIS, PC A20/MF A01.

The document deals with a diachronic perspective of the sociocultural systems of the Bering Strait-Norton Sound area (Shishmaref to Alakanuk including the Bering Strait Islands). The focus is on the Inupiat and Yuit cultural systems of the area, but non-Native sociocultural systems could not be ignored because the area is a functional system. Traditional Inupiat and Yuit culture is considered, the period of initial impact on Native systems by Euroamerican agents of change, the response of this system to change, and the contemporary sociocultural baseline including subsistence, land and sea values, economic systems, political systems, social systems, inethnic relationships, and positive and negative indicators of response to change.

0240 Storage

16505 **(DOE/RA—0047/1) Strategic Petroleum Reserve annual report.** (Department of Energy, Washington, DC (USA)). 16 Feb 1981. 59p. NTIS, PC A04/MF A01.

During 1980, the significant events for the Strategic Petroleum Reserve Program (SPR) included the resumption of oil acquisition, the completion of Phase I facilities, oil withdrawal testing, and commencement of Phase II leaching. The report includes the following contents: introduction and program background; SPR plan and amendments; status of the strategic petroleum reserve which includes program definition, organization, site development, program and project management, budget and cost, real estate, environmental compliance, and permits, and crude oil logistics, distribution, and inventory; drawdown system and vulnerability impact; energy security act implementation; SPR relations with state and local governments; and appendices - SPR site status of Bayou Choctaw, Weeks Island, Bryan Mound, Sulphur Mines, West Hackberry, and St. James Terminal.

0250 Combustion

REFER ALSO TO CITATION(S) 16452, 16455, 16456

16506 **Practical considerations in controlling plume opacity on an oil-fired boiler.** Radway, J.E. (EnerChem Inc., Cleveland, OH); Marshall, F. pp 19, Section 24 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Seattle Steam Corporation encountered severe stack opacity problems when burning a low metal, modest sulfur (1.5%) Alaskan residual oil on a steam heating boiler. A consutant's review revealed that the prior test program had addressed the proper variables but did not fully allow for several key factors. The test program conducted during the 1978-1979 heating season took such factors into account. It explored: (1) combustion modifications to reduce acid formation; (2) chemical neutralization of the acid formed; and (3) control of surface temperatures to prevent any remaining acid from condensing as visible droplets. Equipment limitations prevented significant reduction in SO_3 formation, but opacity was effectively controlled. Chemical neutralization seemed to be the method of choice. However, adverse impacts of certain of the neutralizing additives on boiler heat transfer warranted optimization studies which were made during the winter of 1979-1980. The adverse heat transfer effects were avoided by employing chemical additives that yield an ultra fine magnesium oxide (MgO) particle on combustion. The ultra fine size also provided better chemical ultilization efficiency.

03 NATURAL GAS

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 16524

16507 **(LA-UR—81-735) Remote characterization of tight gas sand formations with a new NMR logging tool.** Jackson, J.A.; Brown, J.A.; Crawford, T.R. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 18p. (CONF-810518—4). NTIS, PC A02/MF A01.

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

A new Nuclear Magnetic Resonance logging technique under development has characteristics which afford several operating and measurement advantages in tight western gas sand formations over existing nuclear magnetic logging tools. Among these are elimination of the need to condition borehole fluids prior to logging a hole, higher sensitivity per unit sample volume, shorter instrumental dead time, and potential for greater formation penetration. The new technique has been laboratory tested in tool geometry. A prototype tool utilizing permanent magnets is under construction and design has started on advanced tools using superconducting magnets.

16508 **(LA-UR—81-736) NMR measurements on Western Gas Sands core.** Brown, J.A.; Brown, L.F.; Jackson, J.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 16p. (CONF-810518—3). NTIS, PC A02/MF A01.

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

Proton longitudinal relaxation (T_1) measurements have been made on several Western Gas Sands core samples. These water-saturated specimens show a distributed relaxation time reflecting the distribution of pore sizes in the sandstone matrix. Mercury porosimeter determinations of the pore-size distributions correlate well with the Nuclear Magnetic Resonance (NMR) measurements, and in addition show a correlation between bulk porosity and pore size. The NMR signal strength is shown to be related to porosity and water saturation, in all but one case.

16509 **(MLM-MU—81-53-0002) Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1, 1980-December 31, 1980.** Zielinski, R.E.; Moteff, J.D. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 276p. (MLM-EGSP-TPR-Q—016). NTIS, PC A13/MF A01.

Data were obtained from wells located in Ohio, Pennsylvania, Michigan, Illinois, Tennessee, and New York. Geochemical analysis was performed including whole rock composition analyses for the following elements: sulfur, uranium, vanadium, nickel, hydrogen, carbon, nitrogen, and oxygen. Also completed were the pyrolysis-gas chromatography and kerogen composition analysis. Hydrocarbon analyses were performed of headspace gases from each well. (DMC)

16510 **(SAND—81-0371C) Model for the high-frequency electrical response of reservoir rocks and its application to dielectric-log interpretation.** Lysne, P. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 28p. (CONF-810518—1). NTIS, PC A03/MF A01.

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

The electrical response of wet reservoir rocks is primarily due to the motion of ions within the pore structure. Electric fields pin some ions at matrix-fluid interfaces, and they contribute to the bulk dielectric properties of the rock. The geometry of the pore structure influences these properties and information concerning it, as well as the water content of the rock, can be inferred from multiple frequency dielectric measurements. Taken together, this information may allow a prediction of the flow properties of the rock.

16511 **(SAND—81-0387C) Application of areal seismics to mapping sandstone channels.** Dobecki, T.L. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 32p. (CONF-810518—2). NTIS, PC A03/MF A01.

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

The seismic formation mapping project is a two-part program whose prime objective is the evaluation of state-of-the-art seismic reflection methods as a means of mapping the subsurface configuration of low permeability sandstone channels - potential gas reservoirs typical of Tertiary and Cretaceous formations of the Western United States. The initial part of the program involved performing a computer model study to predict the effectiveness of seismic techniques applied to such targets and to develop criteria for interpreting real data. The second part consisted of a seismic field experiment designed to test and evaluate the ability to map known lenses. The field program utilized areal (3-D) acquisition methods at a site underlain by known, shallow Mesa Verde channels. Through the lessons learned by seismic modeling, it was possible to interpret field seismic data in terms of channeling and thereby predict the orientation of channels in the subsurface. Projecting these channels out of the area of seismic coverage in order to predict their outcrop position; existing channels which agree quite well with the seismic description and projection were located. It is felt that this exercise has satisfied the program objectives, and that seismic methods may be successfully applied to the description of channel sandstone reservoirs. The next test of this will be in the upcoming DOE-sponsored multi-well experiment.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 16487, 16743

0305 Health And Safety

REFER ALSO TO CITATION(S) 17454

16512 **(DOE/EV/10024—1) Recommended research on LNG safety.** Carpenter, H.J.; Gilmore, F.R. (R and D Associates, Marina del Rey, CA (USA)). Mar 1981. Contract AC03-79EV10024. 304p. NTIS, PC A14/MF A01.

The US Department of Energy (DOE) is conducting research on the safety and other environmental aspects of liquefied energy gases including liquefied natural gas (LNG). The effort reported here was conducted as part of the planning for further research into the safety aspects of transporting and storing LNG, with primary emphasis on public safety. Although the modern LNG industry has enjoyed excellent success in providing for safe operations, significant questions remain on the part of many, the expressions of which were intensified with the addition of marine-based LNG import terminals. Public safety with regard to large-scale importation of this fuel has received widespread attention in the US Congress, state legislatures, county and city governments, and from various individuals and public groups, with coverage in all the news media, including books published on the subject. The safety concerns have centered around the consequences to the public of a large spill of the cryogenic liquid from an ocean tanker or a larger storage tank, either of which might hold as much as 125,000 m^3 of LNG.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 16492, 16493, 16494, 16495, 16496, 16497

16513 **(DOE/EIA—0129(79)) Main-line natural gas sales to industrial users 1979.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas Statistics). Feb 1981. 65p. NTIS, PC A04/MF A01.

Main line natural gas sales by interstate natural gas companies to industrial users are itemized for 1975 to 1979. Information includes company name, customer name, customer's standard industrial classification (SIC), the type of sale (where available), the delivery point, and the state involved in transactions. Tabulations summarize sales by SIC, by state and SIC, and by natural gas companies and SIC. Also summarized are sales by state and type (off-peak, interruptible, and not specified) for the year 1979. An accompanying narrative highlights recent trends and makes comparisons between the two most recent years. 5 tables.

0308 Environmental Effects

REFER ALSO TO CITATION(S) 16500, 16512

16514 **(PB—80-210701) Assessment of potential environmental impacts of geopressured methane development. Final report for 1979.** Golabi, K. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Mar 1980. Contract GRI-5014-321-0182. 300p. NTIS, PC A13/MF A01.

This study presents a critical examination of available information on the characteristics of geopressured methane resources. It identifies and assesses potential environmental impacts and regulatory constraints that may influence the development and commercial use of the resource, and defines issues unique to geopressured methane development. Finally, the study provides a list of recommendations for planning future research efforts.

16515 **(UCID—18585(Suppl.1)) Experimental plan for 40-m^3 liquefied natural gas (LNG) dispersion tests. 1981 tests.** Koopman, R.P.; Lind, C.D. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01.

Details on instruments and types of tests to be performed in the study of liquefied natural gas dispersion at the China Lake

Naval Weapons Center are presented. Possible scheduling of the tests to coincide with the closing of the spill facility is discussed. The experiments will be a continuation of those conducted earlier on gas dispersion. The investigation will be expanded into studies on rapid phase transformation explosions. Combustion and dispersion measurements will be made during vapor cloud fires. (DMC)

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 16481

16516 **(DOE/MC/08089—107) Economic analysis of vertical wells for coalbed methane recovery.** (TRW Energy Systems Group, Morgantown, WV (USA)). Apr 1981. Contract AC21-78MC08089. 62p. NTIS, PC A04/MF A01.

Previous economic studies of the recovery and utilization of methane from coalbeds using vertical wells were based on drainage in advance of mining where a single seam is drained with well spacing designed for rapid predrainage. This study extends the earlier work and shows that methane recovery costs can be reduced significantly by increasing well spacing and draining multiple coalbeds. A favorable return on investment can be realized in many geologic settings using this method. Sensitivity of recovery economics to certain development costs and parametric variations are also examined as are the economics of three methane utilization options.

16517 **(DOE/MC/08216—140) Relationship between photolineaments and Devonian shale gas well productivity; with application to testing of DuPont EL-836 explosive.** Seskus, A.P. (Science Applications, Inc., Morgantown, WV (USA)). Apr 1981. Contract AM21-78MC08216. 39p. NTIS, PC A03/MF A01.

An analysis of the relationship between Devonian Shale gas well productivity in Putnam County, WV and the orientation of, distance to, and density of the nearest photolineament (at scales of 1:32000 and 1:86000) was performed using primarily nonparametric statistical techniques. The results indicate that production is higher within 1300 feet of a low altitude photolineament. There is no association between the orientation of the lineament and productivity. Results on photolineament density are inconclusive. These results appear to be confirmed by the analysis of the DuPont EL-836 explosive tests, which also indicate a statistically significant increase in open flow over conventional shooting.

16518 **(DOE/MC/11577—T9) Small-scale experiments with an analysis to evaluate the effect of tailored pulse loading on fracture and permeability. Final report for phase I, June 11, 1979-June 11, 1980.** McHugh, S. (SRI International, Menlo Park, CA (USA)). Jun 1980. Contract AC21-79MC11577. 203p. NTIS, PC A10/MF A01.

To determine the applicability of the tailored pulse-loading technique to full-scale stimulation, a two-year program was conducted to examine the effects of pulse tailoring on fracture. Results of the field, laboratory, and calculational program demonstrate that: (1) the material and fracture properties derived from laboratory measurements can be used successfully in the NAG-FRAG calculational simulations to reproduce the main features of fracturing in the field; and (2) the fracture patterns produced in these experiments show a strong dependence on the borehole pressure pulse shape. The material and fracture properties will have a significant influence on the fracture patterns. Therefore, shale and tuff will have different optimum pulse shapes.

16519 **(SAND—80-2219C) Hydraulic-fracture propagation in layered rock: experimental studies of fracture containment.** Teufel, L.W.; Clark, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 18p. (CONF-810518—7). NTIS, PC A02/MF A01.

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

Fracture geometry is an important concern in the design of a massive hydraulic fracture treatment for improved natural gas recovery from tight gas sands. Possible prediction of vertical fracture growth and containment in layered rock requires an improved understanding of the parameters which may control fracture growth across layer interfaces. We have conducted laboratory hydraulic fracture experiments and elastic finite element studies which show that at least two distinct geologic conditions may inhibit or contain the vertical growth of hydraulic fractures in layered rock; (1) a weak interfacial shear strength of the layers and (2) a compressional increase in the minimum horizontal stress in the bounding layer. The second condition is more important and more likely to occur at depth. Variations in the horizontal stress can result from differences in elastic properties of individual layers in a layered rock sequence. A compressional increase in the minimum horizontal stress can occur in going from high shear modulus into low shear modulus layers.

16520 **(SAND—80-2307C) Laboratory investigation on the effect of in situ stresses on hydraulic fracture containment.** Warpinski, N.R.; Clark, J.A.; Schmidt, R.A.; Huddle, C.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 24p. (CONF-810518—5). NTIS, PC A02/MF A01.

From Joint SPE/DOE symposium; Denver, CO, USA (27 May 1981).

Laboratory experiments have been conducted to determine the effect of in situ stress variations on hydraulic fracture containment. Fractures were initiated in layered rock samples with prescribed stress variations, and fracture growth characteristics were determined as a function of stress levels. Stress contrasts of 2-3 MPa were found to be sufficient to restrict fracture growth in laboratory samples of Nevada tuff and Tennessee and Nugget sandstones. The required stress level was found not to depend on mechanical rock properties. However, permeability and the resultant pore pressure effects were found to be important. Tests conducted at bimaterial interfaces between Nugget and Tennessee sandstone show that the resultant stresses set up near the interface due to the applied overburden stress affect the fracture behavior in the same way as the applied confining stresses. These results provide a guideline for determining the in situ stress contrast necessary to contain a fracture in a field treatment.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 16503, 16504

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 16512, 16522

0330 Properties

16521 **(PB—80-210685) Liquefied natural gas gels: structure, rheology, and production energy requirements. Final report, January 1976-December 1979.** Reid, R.C.; Shanes, L.M.; Virk, P.S. (Massachusetts Inst. of Tech., Cambridge (USA). Liquefied Natural Gas Research Center). Dec 1979. Contract GRI-5010-352-0011. 81p. NTIS, PC A05/MF A01.

Liquefied natural gas was gelled with two gelants, water and methanol, using a vapor condensation technique. Gelant particle structure analysis, by X-ray diffraction, composition determination and microscopic observation showed that the particles were crystalline clathrate solids with hydrogen bonding between gel particles likely responsible for the observed gel structure. Rheological properties of the gels, derived from their responses to an oscillating shear field, revealed Bingham plastic behavior. Gel yield shear stresses varied from 1 to 100 N/m2 and were dependent upon gelation conditions, increasing both with increasing gelant concentration in the gel and with reduced gelant loading in the carrier gas. LNG gels may offer safety benefits in transporting natural gas. Measurements of LNG gel vaporization from a water surface showed that the gels boiled at rates about one-half those of normal LNG. With rheological data used to predict gel spreading behavior, it was estimated that a typical gel could reduce the maximum distance for flammable mixtures fivefold. Energy requirements for production of LNG gels were estimated. With water as gelant, a gel of yield shear stress 50 N/m2 would require at least 0.073 kg

gelant/kg LNG in gel. Production of such a gel by the present vapor condensation process would entail boiling off approximately one kg of LNG for every kg of LNG gelled; thus the energy requirement for producing gelled LNG would be double that for production of normal LNG, an increase of 100 percent.

16522 **(PB—80-210750) LNG storage: safety analysis. Annual report for 1979.** Reid, R.C.; Smith, K.A.; Virk, P.S. (Massachusetts Inst. of Tech., Cambridge (USA). Liquefied Natural Gas Research Center). Jan 1980. Contract GRI-5014-353-0160. 65p. NTIS, PC A04/MF A01.

Progress is summarized on four projects in the area of LNG safety: (1) Rapid phase transformations in cryogens. An apparatus is described for experiments in which LNG will suddenly be subjected to a shock wave delivered from above. It is anticipated that cessation of boiling, followed by a very rapid delayed phase transformation, may occur. (2) Rollover phenomena. An apparatus is described for experiments which will examine the rates of heat and mass transfer across a density stabilized interface between two miscible strata. Preliminary data show that the apparatus is capable of producing data of the required accuracy. (3) Simultaneous boiling and spreading of cryogenic liquids. An apparatus is described for a study of the subject topic. Data obtained in this apparatus for the case of spreading without boiling are given and are shown to agree with available theories. (4) Modelling of LNG tank dynamics. A vessel containing saturated liquid nitrogen has been subjected to a variety of step changes in the imposed pressure in order to simulate experimentally the events which occur when an LNG tank is subjected to variations in atmospheric pressure. The results are compared with a mathematical model of tank behavior.

16523 **(PB—80-210768) Electrostatic charge generation in hydrocarbon liquids. Final report, January 1978-August 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Liquefied Natural Gas Research Center). Jun 1980. Contract GRI-5010-352-0011. 133p. NTIS, PC A07/MF A01.

A novel method was developed to study the electrification of hydrocarbon liquids. The apparatus is a coaxial cylinder flow generator which contains the test fluid. It is geometrically similar to a Couette viscometer. The electrically grounded, inner metal cylinder (bob) was rotated within an electrically floating metal cup. The induced charge was measured as the electrical potential difference across a capacitor attached to the cup wall. The charging potential was measured as a function of the bob speed, the width of the annulus, and the electrical conductivity of the hydrocarbon liquid. Potentials in the range of 0.1 to 100 volts were obtained. The charging potential was found to increase approximately linearly with bob speed and with gap width, and to decrease approximately as the square root of the conductivity. The observations are compatible with dimensional arguments for the system when combined with a theoretical consideration of the double layer structure. In one series of experiments, the conductivity of toluene was varied by doping with calcium dodecyl sulfosuccinate, a constituent of Shell Anti-Static additive. This provided a method by which the electrical conductivity could be varied without altering the solvent.

0350 Storage

REFER ALSO TO CITATION(S) 16512

04 OIL SHALES AND TAR SANDS

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 16509

16524 **(DOE/METC—2287/112) Sample preparation of x-ray diffraction analysis and clay mineralogy of Devonian shale from the Appalachian basin.** Hosterman, J.W.; Loferski, P.J. (Geological Survey, Reston, VA (USA)). Mar 1981. Contract AI01-76ET10136. 9p. NTIS, PC A02/MF A01.

Three well-known methods of preparing the clay fraction for x-ray diffraction analysis were tested and evaluated. Kaolinite was not identified in samples prepared by the two settling methods because of layering due to differing/settling rates of the clay minerals. It is suggested that if one of the two settling methods of sample preparation is used that the clay film should be thin enough for the x-ray beam to penetrate the entire thickness of clay. The vacuum method of sample preparation is preferred. Chlorite, kaolinite, 2M illite (muscovite), and mixed layer are the clay minerals found by x-ray diffraction analysis in Devonian shale of the Appalachian basin. The proportions of mixed-layer clay minerals were determined by comparing areas of selected basal peaks on x-ray diffraction traces of untreated samples with those of samples that had been heated and saturated by ethylene glycol.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 17355

16525 **(LBL—11650, pp 5.1-5.67) Oil shale research.** Oct 1980.

In Energy and Environment Division annual report, 1979.

Reported are: characterization studies (retort waters, arsenic compounds, process waters, core holes), ecological studies (effects of retort water on benthos), trace element studies (partitioning, Zeeman atomic absorption spectroscopy), retort abandonment (control strategies, cement from spent shale, water quality effects from in-situ leachates, leaching of orgahic C from retorted shale, flow of grouts through rubble), and wastewater treatment. (DLC)

16526 **(UCID—18282(Rev.1)) Oil shale project small retort run summary, Run S-15. Addendum. Computer tables.** Ackerman, F.J.; Sandholtz, W.A.; Raley, J.H.; Mallon, R.G.; Carley, J.F.; Tripp, L.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1981. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

This report presents the computer generated run summary data of Retort Run S-15, as well as mass and energy balance calculations. The tables given in this report should be used in place of those presented in the earlier report. The other materials presented in this report should be used as a supplement to the earlier report since the data presented in that report has not been reproduced here. Retort Run S-15 was a combustion run in the small retort (125 kg retort). The experiment was conducted on December 20-21, 1977. Shale from the Anvil Points mine was crushed and screened to -2.54 + 0.001 cm (-1.0 + 0.0004 inch), then retorted under a 50% air/50% steam atmosphere. S-15 was run under the same gas flow conditions as S-13 and S-14.

16527 **(UCRL—15323) Assessment of international tar sands recovery and upgrading processes.** (Booz, Allen and Hamilton, Inc., Palo Alto, CA (USA)). Dec 1980. Contract W-7405-ENG-48. 373p. NTIS, PC A16/MF A01.

This assessment highlights and evaluates foreign technologies that might aid in the future development of heavy oil deposits in the United States. This information on foreign technology developments would aid in formulating and directing policy decisions on future research programs within the United States. Emphasis of the study was on post-1978 developing technologies. Scope included sizing the resource base and reviewing and evaluating past, present, and planned research and field developments on processes for mining, producing, extracting, and upgrading very heavy oils recovered from tar sands. This report is presented in three major sections with supporting appendices and an executive summary. The characteristics and location of the world's principal tar sands resources are presented in Chapter III. Production methods, both above ground and in-situ, factors inherent in choosing between methods and the commercial and pilot application of those methods are discussed in Chapter IV. Chapter V then presents the factors which affect the process selection for upgrading bitumen and very heavy oils so they can be pipelined and/or refined to a desired mix of consumer products. Chapter V also contains a review of conventional upgrading methods and recent developments, both foreign and domestic. A more detailed discussion of selected US upgrading processes is presented in Appendix I.

16528 **(SAND—81-6001) Process for producing shale oil by in-situ electrothermal pyrolysis in a shale deposit.** Ljungstroem, F. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Translation of Swedish Patent No. 126,674. 9p. NTIS, PC A02/MF A01.

In the process, two heating zones are created in the oil shale deposit. The shale is preheated in the first zone by intermittently applied electric heat, while the preheated shale in the second zone is heated to pyrolysis. Some of the electric heat required for pyrolysis is supplied by a power plant fired by gases generated by the pyrolysis. (DLC)

0405 Properties And Composition

16529 **(DOE/LC/10049—T1) Laboratory evaluation of selected tar sand asphalts.** Button, J.W.; Epps, J.A.; Gallaway, B.M. (Texas Transportation Inst., College Station (USA)). Dec 1980. Contract AC20-78LC10049. 84p. NTIS, PC A05/MF A01.

Three tar sand asphalts of similar grades prepared from one syncrude by three different refining methods were characterized by tests commonly used to specify paving asphalts together with certain special tests. Asphalt-aggregate mixtures were prepared using these asphalts and tested in the laboratory to determine strength stiffness stability, tensile properties, temperature effects and water susceptibility. Comparison of the tar sand asphalt properties to conventional petroleum asphalt properties reveal no striking differences.

16530 **(PB—80-223126) A summary of oil shale activities at the National Bureau of Standards 1975-1979. Final report.** McClendon, L.T. (National Measurement Lab. (NBS), Washington, DC (USA)). Jun 1980. 146p. NTIS, PC A07/MF A01.

This report provides a summary of NBS Oil Shale activities covering the period 1975 to 1979. At the start of this period a Workshop on Standard Reference Materials (SRM's) needed for Oil Shale Processing was held at NBS and served to provide the priority guidance for the future of this program. A summary of the recommendations of that Workshop, the manuscripts presented during the Workshop, and the list of attendees is included in this report. The status of the Oil Shale Research at NBS is also presented consisting of developmental work on the feasibility of producing an Oil Shale and a Shale Oil Standard Reference Materials characterized for both trace inorganic and trace organic constituents. Additionally, information is given dealing with the development of measurement methods appropriate for Oil Shale and Shale Oil trace inorganic and trace organic analysis. Several papers are also included giving additional details on these matters. Other NBS Standard Reference Materials, which may be appropriate for the use by the Oil Shale community, are described briefly within this document. Finally, recommendations for future Oil Shale projects dealing with the development of measurement methods and Standard Reference Materials at NBS are presented.

0406 Direct Uses And By-products

REFER ALSO TO CITATION(S) 16529

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 16527, 17447

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 17456

05 NUCLEAR FUELS

0501 Reserves

16531 **(GJBX—3(81)) Geology and recognition criteria for uranium deposits of the quartz-pebble conglomerate type. Final report.** Button, A.; Adams, S.S. (South Dakota School of Mines and Technology, Rapid City (USA); Adams (Samuel S.) and Associates, Boulder, CO (USA)). Mar 1981. Contract AC13-76GJ01664. 390p. NTIS, PC A17/MF A01.

This report is concerned with Precambrian uraniferous conglomerates. This class of deposit has been estimated to contain between approximately 16 and 35 percent of the global uranium reserve in two rather small areas, one in Canada, the other in South Africa. Similar conglomerates, which are often gold-bearing, are, however, rather widespread, being found in parts of most Precambrian shield areas. Data have been synthesized on the geologic habitat and character of this deposit type. The primary objective has been to provide the most relevant geologic observations in a structural fashion to allow resource studies and exploration to focus on the most prospective targets in the shortest possible time.

16532 **(GJO—112(81)) United States Department of Energy, Grand Junction Office.** (Bendix Field Engineering Corp., Grand Junction, CO (USA)). 1980. Contract AC13-76GJ01664. 25p. NTIS, PC A02/MF A01.

The Grand Junction Office (GJO), US Department of Energy (DOE), develops and administers programs for evaluating domestic uranium resources and the production capability of industry; for developing resource planning information for DOE; and for advancing geologic and geophysical exploration concepts and techniques. In addition, GJO administers the leasing of mineral lands under DOE control, and carries out activities relating to the environmental aspects of uranium mining and milling, including remedial programs. The Office is staffed by administrative and technical program-management personnel. Bendix Field Engineering Corporation (Bendix) is the DOE operating contractor at the Grand Junction, Colorado, Government-owned/contractor-operated (GOCO) facility. The technical staffs of both GJO and Bendix are primarily geoscience-oriented. Specifically during 1980, uranium resource assessment on 135 National Topographic Map Series (NTMS) quadrangles was completed, along with other specific studies, to yield October 1980 national resource estimates. In addition, updated uranium supply analysis and production capability projections were completed. Another key aspect of this successful program was the development of improved geophysical and geochemical equipment and techniques in support of uranium resource assessment. Much of the hardware and know-how developed was turned over to the public and to the uranium industry at large for application to uranium exploration and the assessment of uranium company resources. The Grand Junction Office also participated actively during 1980 in international cooperative research on uranium exploration techniques and on the geology of uranium deposits.

0502 Exploration

REFER ALSO TO CITATION(S) 16531, 16532

16533 **(GJBX—2(81)) Geology and recognition criteria for uraniferous humate deposits, Grants Uranium Region, New Mexico. Final report.** Adams, S.S.; Saucier, A.E. (SEDI-MET, Inc., Albuquerque, NM (USA); Adams (Samuel S.) and Associates, Boulder, CO (USA)). Jan 1981. Contract AC13-76GJ01664. 306p. NTIS, PC A14/MF A01.

The geology of the uraniferous humate uranium deposits of the Grants Uranium Region, northwestern New Mexico, is summarized. The most important conclusions of this study are enumerated. Although the geologic characteristics of the uraniferous humate deposits of the Grants Uranium Region are obviously not common in the world, neither are they bizarre or coincidental. The source of the uranium in the deposits of the Grants Uranium Region is not known with certainty. The depositional environment of the host sediments was apparently the mid and distal portions of a wet alluvial fan system. The influence of structural control on the location

and accumulation of the host sediments is now supported by considerable data. The host sediments possess numerous important characteristics which influenced the formation of uraniferous humate deposits. Ilmenite-magnetite distribution within potential host sandstones is believed to be the simplest and most useful regional alteration pattern related to this type of uranium deposit. A method is presented for organizing geologic observations into what is referred to as recognition criteria. The potential of the United States for new districts similar to the Grants Uranium Region is judged to be low based upon presently available geologic information. Continuing studies on uraniferous humate deposits are desirable in three particular areas.

16534 **(GJBX—9(81)) Statistical techniques applied to aerial radiometric surveys (STAARS): principal components analysis user's manual.** Koch, C.D.; Pirkle, F.L.; Schmidt, J.S. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jan 1981. Contract AC13-76GJ01664. 76p. NTIS, PC A05/MF A01.

A Principal Components Analysis (PCA) has been written to aid in the interpretation of multivariate aerial radiometric data collected by the US Department of Energy (DOE) under the National Uranium Resource Evaluation (NURE) program. The variations exhibited by these data have been reduced and classified into a number of linear combinations by using the PCA program. The PCA program then generates histograms and outlier maps of the individual variates. Black and white plots can be made on a Calcomp plotter by the application of follow-up programs. All programs referred to in this guide were written for a DEC-10. From this analysis a geologist may begin to interpret the data structure. Insight into geological processes underlying the data may be obtained.

16535 **(GJBX—29-80(Pt.6)) Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas.** Butz, T.R.; Wagner, M.E.; Grimes, J.G.; Bard, C.S.; Helgerson, R.N.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Oct 1980. Contract AC13-76GJ01664. 260p. (K/UR—29(Pt.6)). NTIS, PC E09/MF $3.50.

Includes 1 sheet of 48 reduction microfiche.

Results of the Stillwell Mountains project area of the detailed geochemical survey for Trans-Pecos, Texas are reported. Field and laboratory data are presented for 10 groundwater and 228 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the project area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Two groundwater samples from the western section of the project area have the highest uranium values (17.35 and 6.80 ppB). These samples display relatively high concentrations of variables commonly found associated with sulfide mineralization (silver, copper, molybdenum, and selenium). The specific conductance values measured for these two samples represent the second highest and the third lowest values in the project area. The producing horizons of these two samples are inferred to be in or below the Buda Limestone. The two samples occur in a rifted area with stratigraphically Lower Santa Elena Limestone and Tertiary intrusives exposed along the uplifted blocks. Stream sediment samples containing significant amounts of soluble uranium (≧ 1.90 ppM) represent two major areas: along the Rio Grande (trending NE-SW) from Sierra Larga to Big Canyon, and between the Sierra del Carmen Range and Stillwell Mountain (trending NW-SE). Arsenic, beryllium, lithium, molybdenum, selenium, and vanadium are associated with high uranium values in both of the areas. The areas with high uranium values are characterized by extensive Tertiary faulting and folding and Tertiary intrusives.

16536 **(GJBX—29(80)(Pt.7)) Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas.** Butz, T.R.; Wagner, M.E.; Grimes, J.G.; Bard, C.S.; Helgerson, R.N.; Pritz, P.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Oct 1980. Contract AC13-76GJ01664. 277p. (K/UR—29(Pt.7)). NITS, PC E10/MF $3.50.

Includes 1 sheet of 48 reduction microfiche.

Results of the Dryden project area of the detailed geochemical survey for Trans-Pecos, Texas are reported. Field and laboratory data are presented for 34 groundwater and 78 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are given. A generalized geologic map of the project area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Three groundwater samples displaying the highest concentration of uranium occur in the southwest corner of the project area. Relatively high concentrations of the variables boron, chloride, potassium, magnesium, strontium, and sulfate are associated with the uranium. Relating the hydrogeochemical data from an area south of the Dryden project area with results from the Dryden project area indicates that samples exhibiting high uranium concentrations in the Dryden area occur in a transitional zone which is between groundwaters with high values of uranium to the west and low values to the east. Significant soluble uranium concentrations (U-FL) in stream sediments occur in the southeastern corner of the project area. High concentrations of the variables arsenic, calcium, lithium, molybdenum, nickel, phosphorus, selenium, strontium, and vanadium are associated with the area of anomalous uranium. Stream sediment geochemical data from the Dryden project area defines the northern limit of the anomalous uranium trend identified in the south of the Dryden project area. The area of anomalous uranium values corresponds to the area of outcrop of the Lower Boquillas Formation.

16537 **(GJBX—38(81)) Importance of resolution for helium detectors used in uranium exploration.** Zaikowski, A.; Roberts, E.H. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Feb 1981. Contract AC13-76GJ01664. 19p. NTIS, PC A02/MF A01.

A small mass spectrometer of the ^4He detector type used in uranium exploration was modified to enable magnetic scanning of its mass spectrum. Spectra obtained from the instrument allow determination of interferences from adjacent mass peaks. Hydrogen outgassed from the system or produced by molecular dissociation can be a principal extraneous species. If not thoroughly removed from a system, it can contribute to the ion current of the ^4He mass peak. Correlations of ^4He with soil gas moisture found in prior studies may not be due to true variations in ^4He but may be ascribable to artifacts resulting from H_2 contributions to ^4He. Such artifacts can be corrected for by converting field instruments to a scanning mode.

16538 **(GJBX—77(81)) Hydrogeochemical and stream sediment reconnaissance basic data for Dodge City NTMS Quadrangle, Kansas.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Dec 1980. Contract W-7405-ENG-26. 241p. (K/UR—145). NTIS, PC E08/MF $3.50.

Includes 2 sheets of 48x reduction microfiche.

Results of a reconnaissance geochemical survey of the Dodge City Quadrangle are reported. Field and laboratory data are presented for 756 groundwater and 321 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided, and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Groundwater data indicate that the most promising areas for uranium mineralization are as follows: (1) in the north central area of the quadrangle within close proximity to the Arkansas River, mostly from waters of the Ogallala Formation; (2) in the west central area, from groundwater samples of the Dakota and the Ogallala Formations; and (3) between the North Fork of the Cimarron River and the main Cimarron River, mostly in waters from the Ogallala Formation. Associated with the high uranium values are high concentrations for magnesium, strontium, and sulfate. Of the groundwater samples taken 81% were collected from the Ogallala Formation. Stream sediment data indicate high uranium concentrations in scattered samples in the northwestern, central, and southwestern areas of the quadrangle. Most of the samples with high uranium values were collected from the Quaternary alluvium. Associated with the high uranium values are high concentrations of barium, cerium, iron, manganese, titanium, vanadium, yttrium, and zirconium.

16539 **(GJBX—82(81)) Aerial radiometric and magnetic survey: Glasgow National Topographic Map, Montana. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 194p. NTIS, PC E07/MF $4.10.

Includes 12 sheets of 48x reduction microfiche.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Glasgow National Topographic Map NM13-10 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

16540 **(GJBX—83(81)) Aerial radiometric and magnetic survey: Williston National Topographic Map, North Dakota. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 200p. NTIS, PC E07/MF $4.10.

Includes 12 sheets of 48x reduction microfiche.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Williston National Topographic Map NM13-12 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field datas measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

16541 **(GJBX—84(81)) Aerial radiometric and magnetic survey: MC Clusky National Topographic Map, North Dakota. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 192p. NTIS, PC E07/MF $4.10.

Includes 12 sheets of 48x reduction microfiche.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the McClusky National Topographic Map NL14-1 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled date for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

16542 **(GJBX—85(81)) Aerial radiometric and magnetic survey: Bismarck National Topographic Map, North Dakota. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 212p. NTIS, PC E08/MF $4.10.

Includes 12 sheets of 48x reduction microfiche.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Bismarck National Topographic Map NL14-4 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

16543 **(GJBX—86(81)) Aerial radiometric and magnetic survey: McIntosh National Topographic Map, North Dakota/ South Dakota. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 262p. NTIS, PC E10/MF $4.20.

Includes 12 sheets of 48x reduction microfiche.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the McIntosh National Topographic Map NL14-7 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

16544 **(GJBX—87(81)) Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/ Kansas/Nebraska. Final report.** (Geodata International, Inc., Dallas, TX (USA)). 1981. Contract AC13-76GJ01664. 234p. NTIS, PC E09/MF $4.10.

Includes 12 sheets of 48x reduction microfiche.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the Sterling National Topographic Map NK13-12 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included also.

16545 **(GJBX—95(81)) Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Mar 1981. Contract AC13-76GJ01664. 262p. NTIS, PC E09/MF $3.65.

Includes 8 sheets of 48x reduction microfiche.

The Vincennes quadrangle covers 7000 square miles of Indiana, Illinois, and Kentucky within the southeastern Midwestern Physiographic Province. The region contains a moderate to thick section of Paleozoic sediments, which are covered by surficial Quaternary glacial deposits in the western half of the area. A search of available literature revealed no known uranium deposits. Eighty-eight uranium anomalies were detected and are discussed briefly. The average concentrations of potassium, uranium, and thorium are moderate at best. All anomalies appear culturally induced, and none appear to represent significant concentrations of uranium. The mag-

netic data appears to principally reflect the depth and complexities of the Precambrian basement.

16546 **(GJBX—96(81)) Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Mar 1981. Contract AC13-76GJ01664. 266p. NTIS, PC E09/MF $3.65.

Includes 8 sheets of 48x reduction microfiche.

The Cincinnati quadrangle of Indiana, Ohio, and Kentucky covers 7100 square miles of largely agricultural land in the easternmost Midwestern Physiographic Province. Thin Paleozoic strata overlie Precambrian basement in this area. The Paleozoic units are largely masked by Quaternary glacial deposits that thicken to the northwest and northeast. No uranium deposits are known within the quadrangle. The interpretation process defined 86 anomalies, all of which appeared to be culturally induced. None contain significant measured quantities of uranium. Magnetic data appear to be largely in agreement with present structural interpretations, though some other small structures are suggested that could represent complexities in the Precambrian basement.

16547 **(GJBX—97(81)) Aerial gamma ray and magnetic survey, Indianapolis quadrangle, Indiana and Illinois. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Mar 1981. Contract AC13-76GJ01664. 285p. NTIS, PC E10/MF $3.65.

Includes 8 sheets of 48x reduction microfiche.

The Indianapolis quadrangle of Indiana and Illinois covers 7500 square miles of largely agricultural land within the eastern Midwestern Physiographic Province. Moderate to thick sections of Paleozoic rocks are largely masked by overlying Quaternary glacial deposits that represent several Pleistocene glacial advances. No uranium deposits are known in the quadrangle. Though 99 anomalies were defined by the interpretation process, all appeared to be culturally induced. One small group of anomalies overlying strip mines in Pennsylvanian coal deposits have unusually high uranium concentration levels and are thus noteworthy. Magnetic data appear to be largely in agreement with present structural interpretations, though some other structures are suggested that may be complexities in the Precambrian basement.

16548 **(GJBX—99(81)) Geostatistics project of the National Uranium Resource Evaluation program. Progress report, April-September 1980.** Johnson, M.E.; Howell, J.A.; Jackson, C.K.; Patterson, D.; Beckman, R.J.; Campbell, K.; Bement, T.R. (Los Alamos Scientific Lab., NM (USA)). Mar 1981. Contract W-7405-ENG-36. 12p. NTIS, PC A02/MF A01.

A large computer code was written to perform a number of discriminant analysis procedures on aerial radiometric data. Work on percentile estimation, using the normal and log-normal probability distributions, was extended. Additional work was performed on methods of computing with large data sets. Attempts are being made to evaluate the behavior of principal components analysis relative to element distribution in a survey area. We also provided general statistical consulting in such areas as discriminant analysis, filtering, and kriging.

0503 Mining

REFER ALSO TO CITATION(S) 16583, 17242

0504 Feed Processing

REFER ALSO TO CITATION(S) 16701

0505 Enrichment

16549 **(K/CSD/TM—36) Calculation of the isotope distribution in a gas centrifuge.** Park, J.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Feb 1981. Contract W-7405-ENG-26. 64p. NTIS, PC A04/MF A01.

In order to meet commitments to supply uranium enriched in the isotope ^{235}U for use as fuel for power reactors, a gas centrifuge plant is being constructed by the United States government. Development of the process from single laboratory models to prototypes of machines to be used in the plant has been paralleled by the development of theoretical models of the gas flow within the centrifuge. These models allow prediction of the separative capacity as a function of controllable operating and manufacturing parameters such as speed, inventory, length and diameter. In this report, the basic model which describes the differential transport of the desired isotope ^{235}U in the centrifuge flow is discussed. Continuum separation theory is reviewed, appropriate finite difference equations are derived, and three methods of solution are discussed. Finally, the isotope distribution is calculated for a configuration described in the open literature.

16550 **(MLM—2816(OP)) Generalized computer model of the transient behavior of multicomponent isotope-separation cascades.** Rutherford, W.M. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 20p. (CONF-810520—1). NTIS, PC A02/MF A01.

From Symposium on separation science and technology for energy applications; Gatlinburg, TN, USA (5 May 1981).

The time dependent performance of large separation systems is a major consideration in the enrichment of the isotopes of elements that have a direct role in nuclear fuel cycles. The transient behavior of multicomponent separation cascades is described by a set of nonlinear partial differential equations that are similar in form for chemical exchange, distillation, gaseous diffusion, thermal diffusion, and other countercurrent processes. The Mound computer model is set up to solve the differential equations by a fast, implicit forward difference technique. Systems of up to 10 components can be handled with a wide variety of multiple input and output streams. With modifications, the program can be used to model systems of two or more cascades. It has been applied to the separation of the isotopes of uranium, at the noble gases, carbon, oxygen, nitrogen, chlorine, sulfur and calcium. A neon isotope separation problem is given as an example of the precision with which performance can be predicted for multicomponent systems.

16551 **(ORNL-tr—4734) Procedure and device for illuminating a three-dimensional area with a radiation beam.** (Oak Ridge National Lab., TN (USA)). 30 Mar 1979. Translation source information not available . Netherlands Patent 7,902,520. 18p. NTIS, PC A02/MF A01.

In laser isotope separation, a flowing isotopic medium is illuminated with a laser beam. In accord with the invention, the utilization of a laser beam is improved by means of a set of mirrors facing each other. The mirrors are mounted so that multiple reflections can be made between them and the laser beam is focused. (DLC)

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 16851

16552 **Method of evaluating the integrity of the outer carbon layer of triso-coated reactor fuel particles.** Caputo, A.J.; Costanzo, D.A.; Lackey, W.J.; Layton, F.L.; Stinton, D.P. (to Department of Energy). US Patent 4,227,081. 7 Oct 1980. Filed date 13 Jun 1979. vp.

PAT-APPL-048290.

This invention relates to a method for determining defective final layers of carbon on triso-coated fuel particles and the like. Samples of the particles are subjected to a high temperature treatment with gaseous chlorine and thereafter radiographed. The chlorine penetrates through any defective carbon layer and reacts with the underlying silicon carbide resulting in the volatilization of the silicon as sicl4 leaving carbon as a porous layer. This porous carbon layer is easily detected by the radiography.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 17158

16553 (CONF-810337—1) Remotex and servomanipulator needs in nuclear fuel reprocessing plants. Garin, J. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

From Workshop to delineate the economics, technical and policy issues for remote maintenance in energy systems; Gainesville, FL, USA (9 Mar 1981).

Work on the conceptual design of a pilot-scale plant for reprocessing breeder reactor fuels is being performed at Oak Ridge National Laboratory. The plant design will meet all current federal regulations for repocessing plants and will serve as prototype for future production plants. A unique future of the concept is the incorporation of totally remote operation and maintenance of the process equipment within a large barn-like hot cell. This approach, caled Remotex, utilizes servomanipulators coupled with television viewing to extend man's capabilities into the hostile cell environment. The Remotex concept provides significant improvements for fuel reprocessing plants and other nuclear facilities in the areas of safeguarding nuclear materials, reducing radiation exposure, improving plant availability, recovering from unplanned events, and plant decommissioning.

0509 Transport And Storage

16554 (DOE/NV/00597—6) Spent fuel dry storage technology development: report of consolidated thermal data. Lundberg, W.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Sep 1980. Contract AC08-76NV00597. 52p. NTIS, PC A04/MF A01.

Experiments indicate that PWR fuel with decay heat levels in excess of 2 kW could be stored in isolated drywells in Nevada Test Site soil without exceeding the current fuel clad temperature limit (715°F). The document also assesses the ability to thermally analyze near-surface drywells and above-ground storage casks and it identifies analysis development areas. It is concluded that the required analysis procedures, computer programs, etc., are already developed and available. Analysis uncertainties, however, still exist but they lie mainly in the numerical input area. Soil thermal conductivity, of primary importance in analysis, requires additional study to better understand the soil drying mechanism and effects of moisture. Work is also required to develop an internal canister subchannel model. In addition, the ability of the overall drywell thermal model to accommodate thermal interaction effects between adjacent drywells should be confirmed. In the experimental area, tests with two BWR spent fuel assemblies encapsulated in a single canister should be performed to establish the fuel clad and canister temperature relationship. This is needed to supplement similar experimental work which has already been completed with PWR fuel.

16555 (PNL—3566) Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces. Wang, R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1981. Contract AC06-76RL01830. 102p. NTIS, PC A06/MF A01.

Due to the complexity of the structural, microstructural and compositional characteristics of spent fuel, basic leaching and dissolution mechanisms were studied with UO_2 matrix material, specifically with single-crystal UO_2, to isolate individual contributory factors. The effects of oxidation and oxidation-dissolution were investigated in different oxidation conditions, such as in air, oxygenated solutions and deionized water containing H_2O_2. In addition, the effects of temperature on dissolution of UO_2 were studied in autoclaves at 75 and 150°C. Also, oxidation and dissolution measurements were investigated via electrochemical methods to determine if those techniques could be applied to the characterization of leaching and dissolution of spent fuel in a hot cell. Finally, the effects of radiation were explored since the radiolysis of water may create a localized oxidizing condition at or near the spent fuel-solution interface, even in neutral or reducing conditions as commonly found in deep geological environments. The oxidation and oxidation-dissolution mechanisms for UO_2 are proposed as follows: The UO_2 surface is first oxidized in solution to form a UO/sub 2+x/ surface layer several angstroms thick. This oxidized surface has a high dissolution rate since the UO/sub 2+x/ reacts with the dissolved O_2, or H_2O_2, to form uranyl complex ions in a U(VI) state. As the uranyl ions exceed the solubility limits in solution, they become hydrolyzed to form solid deposits and suspended particles of UO_3 hydrates. The thickness and porosity of the deposited UO_3 hydrate surface-film is dependent on temperature, pH and deposition time. A long-term dissolution rate is then determined by the nature of the surface film, such as porosity, solubility and mechanical properties.

16556 (SAND—80-2012) Report on a workshop on transportation-accident scenarios involving spent fuel. Wilmot, E.L.; McClure, J.D.; Luna, R.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 129p. (TTC—0151; CONF-8005151—). NTIS, PC A07/MF A01.

From Workshop on transportation accident scenarios involving spent fuel; Albuquerque, NM, USA (6 May 1980).

Much confusion and skepticism resulted from the scenarios for transportation accidents involving spent fuel that have been presented in environmental impact statements because the supporting assumptions and conclusions from the scenarios did not always appear to be consistent. As a result, the Transportation Technology Center gathered a group whose participants were experts in disciplines related to the transport of spent fuel to consider the scenarios. The group made a number of recommendations about scenario development and about areas in need of further study. This report documents the discussions held and the recommendations and conclusions of the group.

16557 (SAND—80-2124) Transportation accident scenarios for commercial spent fuel. Wilmot, E.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 73p. (TIC—0156). NTIS, PC A04/MF A01.

A spectrum of high severity, low probability, transportation accident scenarios involving commercial spent fuel is presented together with mechanisms, pathways and quantities of material that might be released from spent fuel to the environment. These scenarios are based on conclusions from a workshop, conducted in May 1980 to discuss transportation accident scenarios, in which a group of experts reviewed and critiqued available literature relating to spent fuel behavior and cask response in accidents.

0520 Waste Management

REFER ALSO TO CITATION(S) 16555, 16578, 16580, 16582, 17423, 17545, 17552, 17554

16558 (ORNL-tr—4740) Research and development on ultimate storage of radioactive wastes. Annual report, 1977. (Oak Ridge National Lab., TN (USA)). [nd]. Translation of KFK—2650, June 1978. 40p. NTIS, PC A03/MF A01.

The present deals with the activities of the Entwicklungsgemeinschaft Tieflagerung which was founded on 1 January 1978 and consists of institutes, branches and working groups both of the Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen and the Kernforschungszentrum Karlsruhe which are engaged in the field of radioactive waste disposal. This report presents a survey of the work performed in that field in 1977. The mining and construction work is discussed, which was carried out both underground and above at the Asse Salt Mine near Remlingen and which was done for repair, maintenance, and expansion of operation in accordance with its future purpose. The experimental disposal of low-level wastes on the 750-m and 725-m level was continued in the time period under review. Only seven drums of intermediate-level waste were experimentally disposed of in 1977. The disposal field and the operational equipment for the single test disposal of spent fuel elements from the AVR reactor were completed and are ready for operation. Due to legal, political, and transport problems there is a delay of the start of the test disposal. The mining of the prototype cavity was finished reaching a fina depth of 996.1 m. Moreover, the report gives information on means for radiation protection and the results of the environmental surveillance program. Also the present status of the research activities and their results, especially in the field of disposal of high-level waste, rock mechanics, and safety studies is reported.

16559 (CONF-791234—, pp 123-134) **Waste incineration.** McCormack, M.D. (EG and G Idaho, Inc., Idaho Falls). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

As a result of the information gained from retrieval projects, the decision was made to perform an analysis of all the available incinerators to determine which was best suited for processing the INEL waste. A number of processes were evaluated for incinerators currently funded by DOE and for municipal incinerators. Slagging pyrolysis included the processes of three different manufacturers: Andco-Torrax, FLK and Purox.

16560 (DOE/NWTS—33(2)) **NWTS program criteria for mined geologic disposal of nuclear wasite: site performance criteria.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Feb 1981. Contract AC06-76RL01830. 72p. NTIS, PC A04/MF A01.

This report states ten criteria governing the suitability of sites for mined geologic disposal of high-level radioactive waste. The Department of Energy will use these criteria in its search for sites and will reevaluate their use when the Nuclear Regulatory Commission issues radioactive waste repository rules. These criteria encompass site geometry, geohydrology, geochemistry, geologic characteristics, tectonic environment, human intrusion, surface characteristics, environment, and potential socioeconomic impacts. The contents of this document include background discussion, site performance criteria, and appendices. The background section describes the waste disposal system, the application of the site criteria, and applicable criteria from NWTS-33(1) - Program Objectives, Functional Requirements and System Performance Criteria. Appendix A, entitled Comparison with Other Siting Criteria compares the NWTS criteria with those recommended by other agencies. Appendix B contains DOE responses to public comments received on the January 1980 draft of this document. Appendix C is a glossary.

16561 (LA-UR—81-830) **Nuclear waste disposal facility intrusion: an archeologist's perspective.** Virginia, C.; Christie, L. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 9p. (CONF-810217—12). NTIS, PC A02/MF A01.

From ANS waste management conference; Tucson, AZ, USA (23 Feb 1981).

A scenario is presented for the intrusion of a shallow land burial site by archeologists from a future generation. A description is given for the potential widespread exposure and contamination of populations by recovered artifacts. (DMC)

16562 (ONWI—138) **Preliminary investigation of the thermal and structural influence of crushed-salt backfill on repository disposal rooms.** Wagner, R.A. (RE/SPEC, Inc., Rapid City, SD (USA)). Aug 1980. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01.

The thermal and structural influence of crushed salt backfill within a typical disposal room was investigated. The crushed salt backfill does not significantly influence the heat transfer away from the waste canister region. The degree of consolidation within the crushed salt backfill was assessed to be minimal within a disposal room completely backfilled. If the disposal room was backfilled to approximately 90 percent of capacity, the consolidation of the crushed salt would be almost non-existent. The presence of crushed salt backfill during the initial 25 years after waste emplacement should not significantly enhance or degrade the structural or thermal behavior within the disposal room. However, for greater time, the crushed salt backfill would provide greater structural stability and reduce surface subsidence.

16563 (ONWI—222) **Technical conservatisms in NWTS repository conceptual designs. National Waste Terminal Storage Repository No. 1: special study No. 4.** (Stearns-Roger Services, Inc., Denver, CO (USA)). Sep 1980. Contract AC06-77RL90283;AC06-76RL01830. 100p. NTIS, PC A05/MF A01.

Prior studies have developed conceptual designs for National Waste Terminal Storage Repositories 1 and 2. Due to the considerable detail and volume of the documents describing these designs, it is often difficult to identify and comprehend the substantial conservatisms contained within them. This study identifies and explains the major technical conservatisms in these two conceptual designs in a concise and readily understandable format. The areas discussed include thermal loading of the geologic structure, rock mechanics and underground design, waste throughput capacity, hoisting systems, nuclear criticality safety, confinement of radioactive materials, occupational exposure and health physics, environmental effects, and cost estimates. Conservatisms are described in detail, quantified where possible, and compared to appropriate criteria.

16564 (ORNL/MIT—324) **Simulation of three-phase fluidized bioreactors for denitrification.** Hamza, A.V.; Dolan, J.F.; Wong, E.W. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). Mar 1981. Contract W-7405-ENG-26. 62p. NTIS, PC A04/MF A01.

Fluidized-bed bioreactors were developed and operated at three scales (diameters of 0.1, 0.2, and 0.5 m) by the Chemical Technology Division. The performance of these reactors in denitrification was simulated using the following modified form of Monod kinetics to describe the reaction kinetics: rate = V/sub max/ (NO_3^-/K/sub s/ + NO_3^-) (% biomass). In the fluids-movement portion of the simulation the tanks-in-series approximation to backmixing was used. This approach yielded a V/sub max/ of 3.5 g/m^3-min (% biomass) and a K/sub s/ of 163 g/m^3 for the 0.5-m bioreactor. Values of V/sub max/ and K/sub s/ were also determined for data derived from the 0.1-m bioreactor, but inadequate RTD data reduced the confidence level in these results. A complication in denitrification is the multi-step nature of the reduction from nitrate to nitrite to hyponitrite and finally to nitrogen. An experimental study of the effect of biomass loading upon denitrification was begun. It is recommended that the experimental work be continued.

16565 (PNL—2990) **Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel.** Westerman, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract AC06-76RL01830. 109p. NTIS, PC A06/MF A01.

The present study assumes that the spent fuel will be disposed of in mined repositories in continental geologic formations, and that the post-emplacement control of the radioactive species will be accomplished independently by both the natural barrier, i.e., the geosphere, and the engineered barrier system, i.e., the package components consisting of the stabilizer, the canister, and the overpack; and the barrier components external to the package consisting of the hole sleeve and the backfill medium. The present document provides an overview of the nature of the spent fuel waste; the general approach to waste containment, using the defense-in-depth philosophy; material options, both metallic and nonmetallic, for the components of the engineered barrier system; a set of strawman criteria to guide the development of package/engineered barrier systems; and four preliminary concepts representing differing approaches to the solution of the containment problem. These concepts use: a corrosion-resistant meta canister in a special backfill (2 barriers); a mild steel canister in a corrosion-resistant metallic or nonmetallic hole sleeve, surrounded by a special backfill (2 barriers); a corrosion-resistant canister and a corrosion-resistant overpack (or hole sleeve) in a special backfill (3 barriers); and a mild steel canister in a massive corrosion-resistant bore sleeve surrounded by a polymer layer and a special backfill (3 barriers). The lack of definitive performance requirements makes it impossible to evaluate these concepts on a functional basis at the present time.

16566 (PNL—3090) **Thermal conductivity of multibarrier waste form components.** Lokken, R.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 52p. NTIS, PC A04/MF A01.

The multiple barrier concept of radioactive waste immobilization under investigation at Pacific Northwest Laboratory (PNL) uses composite waste forms which exhibit enhanced inertness through improvements in thermal stability, mechanical strength, and leachability by the use of coatings and metal matrices. Since excessive heat may be generated by radioactive decay of the waste, the thermal conductivity of the various barriers, and more importantly of the composite, becomes an important parameter in design

criteria. This report presents results of thermal conductivity measurements on 21 various glass, ceramic, metal and composite materials used in multibarrier waste forms development.

16567 (PNL-SA—9054) Time and temperature dependence of the leaching of a simulated high-level waste glass. Westsik, J.H. Jr.; Peters, R.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 20p. (CONF-801124—47). NTIS, PC A02/MF A01.

From 3. annual meeting of the Materials Research Society; Boston, MA, USA (17 Nov 1980).

This study investigated how time and temperature affect the leaching of 76-68 waste glass. Two temperature-dependent regions were identified in the results. Above about 250°C, hydrothermal alteration and releases of B, Na, and Mo occur faster than would be expected from the results of tests at lower temperatures. At 250°C and below, leaching appears to proceed through three steps. Characteristically, in the first step, the pH of the leachate changes with time; in the second, the pH is constant and normalized releases based on B, Mo, Na, and Si are described by the empirical equation: Release (g glass/m^2) = kt/sup 0.67(range 0.58-0.75)/, where k follows an Arrhenius temperature dependence (apparent activation energy = 5.3 x 10^4 J/mol °K); and in the third step, so far observed only at 250°C, normalized releases show a weaker time dependence than they do in the second step.

16568 (RHO-BWI—80-100-4Q) Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980. Deju, R.A. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Nov 1980. Contract AC06-77RL01030. 127p. NTIS, PC A07/MF A01.

This report presents the technical progress for the Basalt Waste Isolation Project for the fourth quarter of fiscal year 1980. The overall Basalt Waste Isolation Project is divided into the following principal work areas: systems integration; geosciences; hydrology; engineered barriers; near-surface test facility; engineering testing; and repository studies. Summaries of major accomplishments for each of these areas are reported.

16569 (RHO-BWI-CD—38(Rev.3)) Nuclear waste repository in basalt. Project B-301: functional design criteria. (Kaiser Engineers, Inc., Chicago, IL (USA); Parsons, Brinckerhoff, Quade and Douglas, Inc., New York (USA)). Nov 1980. Contract AC06-77RL01030. 155p. NTIS, PC A08/MF A01.

This document establishes the functional design criteria (FDC) for a federally licensed nuclear waste repository in basalt (NWRB), and supercedes the guidelines set up in 1979, for repository preconceptual design. This FDC has eight sections and five appendices. Section 1.0 outlines the principal functions of the repository, the facilities, and the systems that support repository development and waste-handling operations. The second section contains overall design criteria for the repository. Sections 3.0, 4.0, and 5.0 contain specific criteria for the development and operation of the surface facilities, the access shafts, and the subsurface facilities, respectively. Waste-handling system criteria appear in Section 6.0. Section 7.0 contains criteria for service systems for the developmental and operational phases of the repository. Detailed information on site-specific characteristics (geology, hydrology, etc.) is in Section 8.0. The appendices contain codes, standards, and regulations, bibliography, glossary of terms, acronyms, and personnel requirements.

16570 (RHO-LD—153) Effect of hot-pressing conditions on the properties of iodide sodalite. Winters, W.I. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Dec 1980. Contract AC06-77RL01030. 57p. NTIS, PC A04/MF A01.

Higher hot-pressing temperatures and pressures increase density and reduce porosity and leachability of the iodide sodalite products. The effect of temperature is more significant than pressure with a significantly superior waste form being produced at 1060°C compared to 820°C. Products prepared at 1060°C and 5000 to 7000 psi pressure have apparent densities of 2.60 g/cm^3 (99.5% of theoretical), porosities <0.05%, and cumulative leach rates for 96 h of $<1 \times 10^{-6}$ g/cm^2/d. Iodine concentration in the products is 15 to 20 wt %. These tests further substantiate the viability of using hot-pressed iodide sodalites as long-term waste forms for isolating long-lived ^{129}I from the environment. The products produced at high temperatures are extremely hard, mechanically stable, capable of incorporating large amounts of iodine in a small volume, and have excellent leaching characteristics. In this study, sodalite formed at high temperatures containing 20 wt % iodine, had cumulative fraction leach values of $\sim 2.6 \times 10^{-6}$ cm for 96 h, and incremental leach rates of $\sim 3.2 \times 10^{-7}$ cm/d. Even though initial results look promising, work should continue in the following areas: (1) long-term leaching of products; (2) determine optimum conditions and effect of process variables on hydrothermal reaction; (3) characterize structural, crystal, and mechanical properties of iodide sodalite product; and (4) develop better methods of measuring iodide losses during the process.

16571 (UCID—18845) Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9). Hoenig, C.; Otto, R.; Bazan, C.; Rozsa, R.; Owens, J.; Lim, R.; Smith, G. (Lawrence Livermore National Lab., CA (USA)). 17 Nov 1980. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01.

In this paper, the calculated compositions for three categories of SYNROC powders are recorded and the process by which the powder mixtures are prepared prior to the final hot-pressing step for densification and mineralization is described. The three categories of SYNROC compositions described are: (I) Single phase, which includes the minerals hollandite (SO3) and nepheline (SO8)) (used for cesium leach-rate comparisons in support of our SYNROC D program); (II) SYNROC C three-phase minerals (SO4, SO5, and SO8), which include hollandite, zirconalite, and perovskite; and (III) SYNROC C two-phase minerals (SO9), which include only hollandite and zirconalite. The formulated compositions for all powder mixtures covered in this report are listed.

16572 (UCRL—85032) Application of SYNROC to high-level defense wastes. Tewhey, J.D.; Hoenig, C.L.; Newkirk, H.W.; Rozsa, R.B.; Coles, D.G.; Ryerson, F.J. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 33p. (CONF-810519—1). NTIS, PC A03/MF A01.

From Workshop on alternate nuclear waste forms and interactions in geologic media; Gatlinburg, TN, USA (13 May 1981).

The SYNROC method for immobilization of high-level nuclear reactor wastes is currently being applied to US defense wastes in tank storage at Savannah River, South Carolina. The minerals zirconolite, perovskite, and hollandite are used in SYNROC D formulations to immobilize fission products and actinides that comprise up to 10% of defense waste sludges and coexisting solutions. Additional phases in SYNROC D are nepheline, the host phase for sodium; and spinel, the host for excess aluminum and iron. Up to 70 wt % of calcined sludge can be incorporated with 30 wt % of SYNROC additives to produce a waste form consisting of 10% nepheline, 30% spinel, and approximately 20% each of the radioactive waste-bearing phases. Urea coprecipitation and spray drying/calcining methods have been used in the laboratory to produce homogeneous, reactive ceramic powders. Hot pressing and sintering at temperatures from 1000 to 1100°C result in waste form products with greater than 97% of theoretical density. Hot isostatic pressing has recently been implemented as a processing alternative. Characterization of waste-form mineralogy has been done by means of XRD, SEM, and electron microprobe. Leaching of SYNROC D samples is currently being carried out. Assessment of radiation damage effects and physical properties of SYNROC D will commence in FY 81.

16573 (PNL-TR—410) Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report. Henrikson, S.; de Pourbaix, M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 7 Apr 1981. Translation of STUDSVIK-E1--79/83, 7 May 1979. 42p. NTIS, PC A03/MF A01.

On the commission of the Nuclear Safety Project (KBS) corrosion tests have been carried out on unalloyed titanium, which is planned to be used as an outer corrosion-resistant canister for re-

processed nuclear waste. Tests were conducted for 300 days in a corrosive medium of modified Baltic water at 100 and 130°C with high (8 ppM) or low (< 10 ppB) oxygen content. The tests at low oxygen content and 100°C were continued for 600 days. Very low oxidation rates (0.01-0.1 μm/year) were obtained, corresponding to a lifetime of tens to hundreds of thousands of years for a 6-mm-thick titanium canister. In spite of the considerably more severe corrosion conditions (higher temperature, higher chloride and fluoride contents, as well as lower pH) compared with those estimated for the final disposal, no signs of localized corrosion were found, nor could any hydrogen pick-up be detected.

16574 **Method for immobilizing radioactive iodine.** Babad, H.; Strachan, D. M. (to Department of Energy). US Patent 4,229,317. 21 Oct 1980. Filed date 4 Dec 1978. vp. PAT-APPL-966522.

Radioactive iodine, present as alkali metal iodides or iodates in an aqueous solution, is incorporated into an inert solid material for long-term storage by adding to the solution a stoichiometric amount with respect to the formation of a sodalite (3M2O.3Al2O3. 6SiO2.2MX, where M alkali metal; X I^- or IO^{3-}) of an alkali metal, alumina and silica, stirring the solution to form a homogeneous mixture, drying the mixture to form a powder, compacting and sintering the compacted powder at 1073 to 1373 K (800° to 1100° C.) for a time sufficient to form sodalite.

16575 **(ORNL-tr—4739) Calculations on heat generation in the storage and solidification of MLW/LLW in large-capacity caverns (Reference systems A and B of the in-situ project).** Hauser, W.; Smailos, E.; Koester, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Dept. of Radioactive Waste Treatment). Sep 1979. Translation of KfK—2857. 32p. NTIS, PC A03/MF A01.

In this work investigations were made on the conditions under which the containerless final disposal of liquid radioactive MLW/LLW (in-situ project) from the back-end fuel cycle center in caverns of 82,500 m^3 (and 134,000 m^3), respectively) capacity (reference systems A and B) about 1,000 m below ground level will be feasible without involving problems of heating. The waste product to be introduced by layers via a vertical pipeline in reference system A consists of a cemented granulated material (diameter about 10 mm) containing the MLW/LLW concentrate, and a cementitious grout mixed with tritium effluents, which serves as the filler material. In reference system B the cemented MLW/LLW concentrate is packed into 200 to 400 1 units. The maximum permissible temperature for the waste product is fixed at 90°C for reasons of product quality.

16576 **(EGG-WM—5393) Site selection criteria for the shallow land burial of low-level radioactive waste.** Falconer, K.L.; Hull, L.C.; Mizell, S.A. (EG and G Idaho, Inc., Idaho Falls (USA)). [nd]. Contract AC07-76ID01570. 13p. NTIS, PC A02/MF A01.

The shallow land burial of low-level waste must be accomplished in a manner that ensures the public and biosphere are protected from harmful amounts of radiation. This can be attained by selecting, designing, operating and closing sites such that contaminants never leave the site boundary in levels above regulatory limits. Site design, operation and closure are all functions of the characteristics of the site selected. As a result, the site selection process offers the most effective means for optimizing safe, efficient and economical low-level waste burial practices. The purpose of this document is to set forth criteria for the selection of shallow land burial sites. Criteria are standard rules, by which the ability of a site to meet waste management goals can be judged. They are comprehensive, universal, and qualitative and are applicable in any geologic environment. Site selection criteria provide the framework for the siting process.

16577 **(UR—3490-1978) Low-level radioactive biomedical wastes.** Casarett, G.W. (Rochester Univ., NY (USA). School of Medicine and Dentistry). [nd]. Contract AC02-76EV03490. 18p. NTIS, PC A02/MF A01.

A summary of the management and hazards of low-level radioactive biomedical wastes is presented. The volume, disposal methods, current problems, regulatory agencies, and possible solutions to disposal problems are discussed. The benefits derived from using radioactivity in medicine are briefly described. Potential health risks are discussed. The radioactivity in most of the radioactive biomedical waste is a small fraction of that contained naturally in the human body or in the natural environment. Benefit-risk-cost considerations are presented. The cost of managing these wastes is getting so high that a new perspective for comparison of radioactivity (facts, risks, costs, benefits and trade-offs) and alternate approaches to minimize the risk and cost and maximize the benefits is suggested. (DMC)

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 16567, 16576, 17383, 17459

16578 **(LA—8691-PR) Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980.** Daniels, W.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Feb 1981. Contract W-7405-ENG-36. 19p. NTIS, PC A02/MF A01.

This quarterly report presents Los Alamos National Laboratory contributions to the Waste/Rock Interactions Technology program, Tasks 3 and 4, for the first quarter of FY-1981. Much of the activity during the first quarter of FY-1981 involved sorption studies needed to continue studies of sorption isotherms and the effect of solution-to-solid ratios and to continue measurements of migration rates in crushed, fractured, and porous materials. Results from batch measurements of the element-concentration dependence of sorption ratios for cesium, strontium, barium, and europium on Climax Stock granite and Eleana argillite were reported earlier. The studies have now been extended to cerium on argillite and granite and to plutonium on granite and results are reported.

16579 **(ORNL—5601) FEMWASTE: a Finite-Element Model of Waste transport through porous saturated-unsaturated media.** Yeh, G.T.; Ward, D.S. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 145p. NTIS, PC A08/MF A01.

A two-dimensional transient model for the transport of dissolved constituents through porous media originally developed at Oak Ridge National Laboratory (ORNL) has been expanded and modified. Transport mechanisms include: convection, hydrodynamic dispersion, chemical sorption, and first-order decay. Implementation of quadrilateral iso-parametric finite elements, bilinear spatial interpolation, asymmetric weighting functions, several time-marching techniques, and Gaussian elimination are employed in the numerical formulation. A comparative example is included to demonstrate the difference between the new and original models. Results from 12 alternative numerical schemes of the new model are compared. The waste transport model is compatible with the water flow model developed at ORNL for predicting convective Darcy velocities in porous media which may be partially saturated.

16580 **(PNL—3414) Potential influence of organic compounds on the transport of radionuclides from a geologic repository. Assessment of effectiveness of geologic isolation systems.** Silviera, D.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1981. Contract AC06-76RL01830. 42p. NTIS, PC A04/MF A01.

This study identifies organic compounds that may be present in a repository and outlines plausible interactions and mechanisms that may influence the forms and chemical behavior of these compounds. A review of the literature indicates that large quantities of organic radioactive wastes are generated by the nuclear industry and if placed in a repository could increase or decrease the leach rate and sorption characteristics of waste radionuclides. The association of radionuclides with organic matter can render the nuclides soluble or insoluble depending on the particular nuclide and such parameters as the pH, Eh, and temperature of the hydrogeologic system as well as the properties of the organic compounds themselves. 44 references.

0540 Health And Safety

REFER ALSO TO CITATION(S) 16561, 17206, 17380

16581 (CONF-791234—, pp 110-122) **New decontamination technologies for environmental applications.** Allen, R.P.; Arrowsmith, H.W.; McCoy, M.W. (Pacific Northwest Lab., Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The technologies discussed represent a versatile collection of tools and approaches for environmental decontamination applications. The fixatives provide a means for gaining and maintaining control of large contaminated areas, for decontaminating large surface areas, and for protecting equipment and supplies used in decontamination operations. The other decontamination techniques together provide a method for removing loose surface contamination from almost all classes of materials and surfaces. These techniques should have wide application both as direct decontamination processes and for the cleaning of tools and equipment used in the decontamination operations.

16582 **(DOE/AL/10752—10) Radiological health review of the Final Environmental Impact Statement Waste Isolation Pilot Plant. Volumes 1 and 2. DOE/EIS-0026.** (New Mexico Health and Environment Dept., Santa Fe (USA)). Jan 1981. Contract AC04-78AL10752. 57p. NTIS, PC A04/MF A01.

Purpose of the Environmental Evaluation Group (EEG) is to conduct an independent technical evaluation of the potential radiation exposure to people from the proposed Federal radioactive Waste Isolation Pilot Plant (WIPP) near Carlsbad, in order to protect the public health and safety and ensure that there is minimal environmental degradation. Analyses are conducted of reports issued by the US DOE and its contractors, other Federal agencies and other organizations, as they relate to the potential health, safety and environmental impacts from WIPP.

16583 **Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance.** Henry, C.D.; Kapadia, R.R. Austin, TX; Bureau of Economic Geology (1980). 56p. (NP—25365).

Mo, As, and Se are concentrated with uranium in ore deposits in South Texas. Two sets of oil samples were collected and analyzed for Mo, As, Se, and Cu. Two hundred and fifty-six samples were collected in a statistically random design from soils developed on the Whitsett Formation, Catahoula Formation, or Oakville Sandstone, the major uranium hosts of the area, and 182 samples were collected nonrandomly from areas of mining or mineralization. Random sampling results show that the Whitsett Formation has higher Mo and lower Cu concentrations than the other two formations. With the exception of Mo in the Whitsett Formation and Cu in all three formations, the trace element concentrations are similar to published average concentrations in soils worldwide. Sampling in areas of mining and mineralization indicates that high concentrations of Mo, As, or Se occur dominantly in areas of shallow mineralization and in drainages adjacent to older abandoned mines. Moderately high concentrations also occur in a few reclaimed areas. Windblown dust from mining areas has not measurably affected trace element concentrations in adjacent areas. Comparison of Mo and Cu concenrations in soils and grasses suggest that forage in the area studied could induce molybdenosis in cattle.

0550 Regulations

REFER ALSO TO CITATION(S) 16907, 17158

16584 **(K/OA—4955) Selection of potential IAEA inspection strategies involving cascade access at the Portsmouth Gas Centrifuge Enrichment Plant (GCEP).** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 13 Apr 1981. Contract W-7405-ENG-26. 38p. NTIS, PC A03/MF A01.

This report has been prepared as a US contribution to Team 4 of the Hexapartite Safeguards Project. It provides to the Team 4 participants one example of an approach, which has been used in the United States, to developing a range of safeguards strategies involving differing degrees of access to cascade areas of centrifuge enrichment plants. Its purpose is to facilitate the work of other Hexapartite participants in completing Task II of Team 4's terms of reference. The scope of this report is limited to identifying safeguards approaches for the Portsmouth Gas Centrifuge Enrichment Plant (GCEP) which involve differing degrees of access to the cascade area. This report provides a method for selecting cascade access inspection strategies at GCEP which appear promising for more detailed evaluation. It is quite important to note, however, that the effectiveness and practicability of these strategies have not been established at the present. In addition, some strategies have been included on the basis of very preliminary calculations and considerations which have not been validated. Thus, some of these strategies may ultimately be rejected because they prove to be impracticable. Considerations of cost and the possible transfer of information and technology related to the production of enriched uranium will also be pertinent in considering the degrees and frequency of access to the cascade areas of centrifuge enrichment plants. This report describes the process for combining technical measures, implementation approaches and objectives to arrive at the total number of theoretically possible combinations. It then describes how these combinations may be reduced in a series of steps to a number that is more manageable for detailed evaluation. The process is shown schematically.

06 FUSION FUELS

0602 Processing

16585 **(DOE/DP/40083—1) Automated fabrication, characterization and transport of ICF pellets. Final report, March 1, 1979-October 31, 1980.** Clifford, .D.W.; Boyd, B.A.; Lilienkamp, R.H. (McDonnell Douglas Astronautics Co., St. Louis, MO (USA)). Dec 1980. Contract AC08-79DP40083. 143p. NTIS, PC A07/MF A01.

The near-term objectives of the contract were threefold: (1) evaluate techniques for the production of frozen hydrogen microspheres and demonstrate concepts for coating them; (2) develop and demonstrate an optical characterization system which could lead to automated pellet inspection; and (3) develop and demonstrate a preliminary electrostatic pellet transport control system. This report describes the equipment assembled for these experiments and the results obtained.

16586 **Cryogenic laser fusion targets by point-contact conduction cooling.** Fries, R.J. (Univ of Calif, Los Alamos Sci Lab, NM). *AIChE (American Institute of Chemical Engineers) Symposium Series ;* **75**: No. 191, 219-227(1979). (CONF-771102—).

From 70. annual AICHE meeting; New York, NY, USA (13 Nov 1977).

It is demonstrated that the point-contact conduction cooling technique is a useful means of forming and maintaining cryogenic fuel configurations for inertial confinement fusion experiments. Apparatus for cryogenic experiments using conduction cooling can be readily incorporated into a target chamber without disturbing target illumination or diagnostic instrumentation. In its application to date, the technique has been successful in producing quite uniform layers of liquid deuterium; DT layers have been less uniform. A better understanding of this nonuniformity is needed. In glass shell targets in the 50-/mu/m to 120-/mu/m size, filled with 90 atm. or more fuel, a liquid film has been maintained in a stable configuration for several minutes. Most significantly, these experiments indicate that cryogenic fuel configurations in glass shell targets (at high fill pressures) can give larger neutron yields than those of equivalent room-temperature targets. 14 refs.

16587 **High-gain, low-intensity ICF targets for a charged-particle beam fusion driver.** Sweeney, M.A.; Farnsworth, A.V. Jr. (Sandia Labs., Albuquerque, NM (USA)). *Nuclear Fusion ;* **21**: No. 1, 41-54(Jan 1981).

A class of high-gain ICF targets driven by electrons or light ions is discussed. The targets are characterized by a low-beam-intensity requirement and large size. A magnetic field provides thermal insulation of pre-heated, low-density fuel. The addition of a

cryogenic fuel layer increases the gain without requiring significantly increased beam power and intensity. The higher fuel adiabat and reduced fuel losses produce ignition and burn for lower implosion velocities and at lower power and intensity than conventional ablative designs. Gains of 20 to 40 are expected for intensities of approximately <80 TW.cm^{-2}, initial magnetic fields of approximately >30-60 kG, an initial fuel radius of 0.2-0.4 cm, and irradiation uniformities of 6-7%. Driver requirements are approximately <45 TW.cm^{-2} if the initial magnetic field is approximately >300-600 kG, sufficient for alpha trapping in the compressed low-density fuel. Voltage shaping increases fuel burn-up and target rhor and lowers power and intensity levels by an additional factor of about 0.6.

0603 By-products

16588 **Synthetic fuels from laser fusion.** Gomberg, H.J. (KMS Fusion, Inc, Ann Arbor, Mich). *AIChE (American Institute of Chemical Engineers) Symposium Series ;* **75**: No. 191, 193-195(1979). (CONF-771102—).

From 70. annual AICHE meeting; New York, NY, USA (13 Nov 1977).

The author believes that there are many attractive concepts that are available for laser fusion power beyond the concept primarily in vogue today, that of large, 3,000 to 5,000-MW fusion reactors generating electricity. It is felt that there is opportunity for the direct conversion of laser fusion energy to chemical energy through radiolytic-thermochemical cycles. These cycles effectively split up water into its components, hydrogen and oxygen, and will provide a source of inexpensive hydrogen that can be converted to methane for integration into the existing natural gas pipeline system, or to methanol for use in slightly modified automobile internal combustion engines. 2 refs.

0605 Health And Safety

REFER ALSO TO CITATION(S) 17206

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

16589 **(MLM—2809) Mound Facility activities in chemical and physical research: July-December 1980.** (Mound Facility, Miamisburg, OH (USA)). 10 Apr 1981. Contract AC04-76DP00053. 50p. NTIS, PC A03/MF A01.

Progress is reported in three areas: low-temperature research (thermometry, differential vapor pressure measurements on ortho-para D_2 mixtures, differential scattering of para-H_2, low-temperature trennschaukel), separation research (liquid phase thermal diffusion of alkyl halides, ^{35}Cl separation, Ca isotope separation by liquid thermal diffusion, Ca chemical exchange, mutual diffusion of Ar-He, Ne dimer formation in supersonic nozzles), and calculations in plutonium chemistry (valence state distributions, estimation of Pu(V) content in environmental waters, disproportionation of Pu(V). (DLC)

0702 Radiation Sources

16590 **(SAND—81-7069) Design criteria for dry-sludge irradiation demonstration plant (DSIDP).** (Molzen-Corbin and Associates, Inc., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 108p. NTIS, PC A06/MF A01.

The DSIDP is to process up to 25 tons of dry sewage sludge per day on a 24 hour day basis. The sludge will be either in 40 pound bags or bulk and will be subjected to a radiation dose of 1 Mrad. The low energy (0.66 million electron volt) gamma rays from cesium-137 will not induce any radioactivity in the sludge. The radiation will disinfect the sludge for use as a fertilizer, soil conditioner, livestock feed, and other possible uses. More sludge can be treated at a lower radiation dose by speeding up the bucket conveyor.

0703 Isotopic Power Supplies

16591 **(PNL—1845-49) Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for October-December 1980.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1981. Contract AC06-76RL01830. 10p. NTIS, PC A02/MF A01.

At Hanford, strontium is separated from the high-level waste, converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation, and storage take place in the Waste Encapsulation and Storage Facilities (WESF). The encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat-source applications under anticipated-use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF2$ capsules. The information needed for licensing can be divided into three general task areas: Task 1 - Chemical and Physical Properties of $^{90}SrF_2$; Task 2 - $^{90}SrF_2$ Compatibility Studies; and Task 3 - Capsule Qualification and Licensing. Efforts are proceeding concurrently on all three tasks to obtain the required information.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 16602, 16654

16592 **(BNL—51309) Hydrogen production from small hyropower sites. Final report.** (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract AC02-76CH00016. 83p. NTIS, PC A05/MF A01.

A synergistic relationship was not found to exist between low-head hydropower and electrolytic hydrogen production. The storageability of hydrogen was expected to mitigate problems of hydrogen generation variability associated with the use of low-head hydropower as the power source. The expense of gaseous hydrogen storage equipment effectively eliminates storage as a means to decouple hydrogen demand and power/hydrogen production. From the opposite perspective, the availability of a low and stable cost of power from low-head hydro was expected to improve the competitiveness of electrolysis. In actuality, the results indicated that hydroelectric power from small dams would be comparatively expensive by current grid power standards (mid-1979). Electrolysis, in the capacity range considered here, is less sensitive to the cost of the power than originally presumed. Other costs including depreciation and capital related charges are more significant. Due to power generation variability, sole reliance on low-head hydropower to provide electricity to the cells would reduce the utilization of the hydrogen production investment, resulting in an increase in unit production costs. These factors were paramount in the Air Products recommendation to discontinue the study before continuing to more detailed stages of analysis, including an analysis of a site specific facility and the construction of a demonstration facility. Another major factor was the unavailability of a pipeline hydrogen supply situation which, because of lower distribution and capital costs, could have been commercially viable. An unfavorable judgment on the combined facility should not be misinterpreted and extended to the component systems. Although a detailed analysis of the individual prospects for electrolysis and low-head hydropower was beyond the study scope, the reader will realize, as the study is reviewed, that each is worthy of individual consideration.

16593 **(CONF-810345—1) Photosynthetic water splitting.** Greenbaum, E. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 16p. NTIS, PC A02/MF A01.

From 1. SERI solar hydrogen production program contractors' review meeting; Washington, DC, USA (26 Mar 1981).

The photosynthetic unit of hydrogen evolution, the turnover time of photosynthetic hydrogen production, and hydrogenic photosynthesis are discussed in the section on previous work. Recent

results are given on simultaneous photoproduction of hydrogen and oxygen, kinetic studies, microscopic marine algae-seaweeds, and oxygen profiles.

16594 **(PB—80-210776) Thermochemical hydrogen production. Annual report for 1979.** Foh, S.E.; Schreiber, J.D.; Pangborn, J.B.; Whaley, T.P. (Institute of Gas Technology, Chicago, IL (USA)). May 1980. Contract GRI-5014-323-0017. 193p. NTIS, PC A09/MF A01.

In 1979, chemical cycle development for water splitting to produce hydrogen and oxygen was advanced through research on technically promising sequences of thermochemical and electrochemical reactions. One of the reaction sequences or cycles is based on copper oxide and sulfate chemistry, a similar one uses zinc chemistry, and one is a solar energy cycle that uses cadmium chemistry. The most promising copper cycle was demonstrated in the laboratory with recycled materials, and the zinc sulfate cycle was improved in energy efficiency through a procedure that decreases thermal separation requirements. The electrochemical step of the cadmium cycle achieved efficient operation at low voltage potentials. An analysis of the interfacing of primary heat sources with thermochemical or thermoelectrochemical hydrogen production processes was performed. Also accomplished was a study assessing the impacts of materials development for thermochemical water-splitting cycles.

16595 **(PB—80-813553) Hydrogen production. 1977-July 1980 (citations from the International Aerospace Abstracts data base). Report for 1977-July 1980.** Zollars, G.F. (New Mexico Univ., Albuquerque (USA). Technology Application Center). Aug 1980. 88p. NTIS PC N01/MF N01.

This bibliography cites reports which discuss techniques such as solar energy conversion, coal gasification, thermal dissociation, and photolysis in addition to water electrolysis. (This updated bibliography contains 344 citations, 175 of which are new entries to the previous edition.)

16596 **(TAC-H—80-004) Hydrogen energy: a bibliography with abstracts. Quarterly update: October-December 1980.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Jan 1981. 128p. Univ. of New Mexico, Albuquerque.

This update cites 312 additional references on the suject of hydrogen as a secondary fuel and as an energy carrier. The subject areas include production, utilization, safety, materials, transmission, distribution, and storage.

16597 **Thermochemical cyclic system for decomposing H_2O and/or CO_2 by means of cerium-titanium-sodium-oxygen compounds.** Bamberger, C.E. (to Dept. of Energy). US Patent Application 143,253. 24 Apr 1980. 16p.

A thermochemical closed cyclic process for the decomposition of water and/or carbon dioxide to hydrogen and/or carbon monoxide begins with the reaction of ceric oxide (CeO_2), titanium dioxide (TiO_2) and sodium titanate (Na_2TiO_3) to form sodium cerous titanate ($NaCeTi_2O_6$) and oxygen. Sodium cerous titanate ($NaCeTi_2O_6$) reacted with sodium carbonate (Na_2CO_3) in the presence of steam, produces hydrogen. The same reaction, in the absence of steam, produces carbon monoxide. The products, ceric oxide and sodium titanate, obtained in either case, are treated with carbon dioxide and water to produce ceric oxide, titanium dioxide, sodium titanate, and sodium bicarbonate. After dissolving sodium bicarbonate from the mixture in water, the remaining insoluble compounds are used as starting materials for a subsequent cycle. The sodium bicarbonate can be converted to sodium carbonate by heating and returned to the cycle.

0802 Storage

REFER ALSO TO CITATION(S) 16427, 16596, 17101

16598 **(BNL—51275) Underground hydrogen storage. Final report.** Foh, S.; Novil, M.; Rockar, E.; Randolph, P. (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract AC02-76CH00016. 268p. NTIS, PC A12/MF A01.

The technical and economic feasibility of storing hydrogen in underground storage reservoirs is evaluated. The past and present technology of storing gases, primarily natural gas is reviewed. Four types of reservoirs are examined: salt caverns, excavated caverns, aquifers, and depleted fields. A technical investigation of hydrogen properties reveals that only hydrogen embrittlement places a limit on the underground storage by hydrogen. This constraint will limit reservoir pressures to 1200 psi or less. A model was developed to determine economic feasibility. After making reasonable assumptions that a utility might make in determining whether to proceed with a new storage operation, the model was tested and verified on natural gas storage. A parameteric analysis was made on some of the input parameters of the model to determine the sensitivity of the cost of service to them. Once the model was verified it was used to compute the cost of service of storing hydrogen in the four reservoir types. The costs of service for hydrogen storage ranged from 26 to 150% of the cost of the gas stored. The study concludes that it is now both safe and economic to store hydrogen in underground reservoirs.

16599 **(DOE/ER/05246—T1) Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1980-February 28, 1981.** Livesay, B.R.; Larsen, J.W. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 28 Feb 1981. Contract AS05-76ER05246. 72p. NTIS, PC A04/MF A01.

Objective is to study the relations between structural and physical characteristics and the hydrogen interaction kinetics of the AB_5 transition metal-rare earth compounds. $LaCo_5$ and $LaNi_5$ were mainly used. Magnetic studies is providing details on the Ni-rich precipitates in $LaNi_5$. Reactions with poison gases indicate that storage alloy surface segregation results from the chemical potential associated with oxygen at the alloy surface. SEM micrographs show that each $LaNi_5$ particle has a large number of facets. (DLC)

16600 **(JUEL—1648) Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements.** Arnold, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Feb 1980. 95p. NTIS (US Sales Only), PC A05/MF A01.

The solubility of hydrogen and deuterium in $Fe_{0.8}Ti_{0.8}$ is studied. Macroscopic samples are charged from the gas phase without permeation barriers. The absolute concentration and its time dependence is determined from measurements of the electrical resistivity. The specific change in resistivity per unit concentration is 820 μΩcm for both H_2 and D_2. The solution for both gases is endothermic; the solubility limit is given by 1g x/sub α/ = 1.1 - 1340/T. The partial molar quantities are calculated for infinite dilution. For hydrogen (and deuterium) the enthalpy of solution is 10.65 kJ/mol/sub H/ (9.50 kJ/mol/sub D/), the excess entropy of solution is -39.0 J/K mol/sub H/ -41.7 J/K mol/sub D/. Absorption and desorption measurements give the following values for the diffusion constant (mean values): D/sub H/ = 7.8 x 10^{-4} cm^2/s x exp (0.5 eV/kT), D/sub D/ = 7\6.9 x 10^{-4} cm^2/s x exp (0.49 eV/kT). The activation model which is based on the segregation of iron clusters at the surface is indirectly verified.

16601 **(ORNL/TM—7561) Modeling solid hydrogen storage beds.** Fisher, P.W.; Watson, J.S. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 41p. NTIS, PC A03/MF A01.

Mathematical models have been developed to predict the performance of metal-hydride beds used for hydrogen storage. The relative importance of heat transfer, mass transfer, chemical kinetics, and equilibrium have been evaluated by comparison of the models with experimental data supplied by Brookhaven National Laboratory for a cylindrical bed containing iron-titanium (FeTi) alloy. Of these factors, only mass transfer was found to be of negligible importance. An equilibrium model containing no empirical parameters produces bed pressure and temperatures that show good agreement with experimental data; however, events such as maximum pressure and centerline temperatures are predicted at times that differ from those observed. This model is used to evaluate two proposed designs for solid hydrogen storage beds in which: (1) FeTi alloy is contained in tubes that are externally cooled, and (2)

FeTi alloy is contained in a bed that is penetrated by cooling tubes. The model predicts that heat transfer surface area is utilized most effectively with the second cooling and configuration. Including first-order chemical kinetics in the model produces a good fit to total loading times for all runs using two empirical rate constants, one for absorption and one for desorption.

0803 Transport

REFER ALSO TO CITATION(S) 16596

0804 Marketing And Economics

REFER ALSO TO CITATION(S) 16598

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 16596

09 OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 16939

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 16649, 16650, 16654, 16661, 16664, 16990, 17181, 17559, 17906

16602 **(COO—4946-3) Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981.** Chung, Y.W. (Northwestern Univ., Evanston, IL (USA)). Feb 1981. Contract AS02-78ER04946. 28p. NTIS, PC A03/MF A01.

It was shown that CO hydrogenation reactions can be performed reproducibly on a small area well characterized Ni (111) single crystal using an isolation cell technique. The activation energy for methane production (24.7 kcal/mole) and other hydrocarbon product distribution are in excellent agreement with the literature. It was demonstrated that Ni dispersed onto TiO_2 (100) acquires a negative charge and that the Ni/TiO_2 (100) exhibits a methanation activity at least 4 times that of Ni(111) with about the same activation energy. The Ni/TiO_2 also produces more higher hydrocarbons than Ni(111). The photochemical activity of Pt/$SrTiO_3$ in both aqueous solutions and in gas phase water was examined. The activity in aqueous solutions under different conditions of pH and Pt coverage can be explained by band bending effects. A low hydrogen yield was observed in the presence of water vapor; this was attributed to a slow photo-regeneration of active surface Ti^{3+}. Preliminary high resolution electron energy loss studies on TiO_2 (100) showed strong surface phonon bands extending to 3000 cm^{-1}.

16603 **(DOE/CS/24310—2) Full scale field demonstration of unheated anaerobic contact stabilization. Quarterly project status report, July 1980-September 1980.** Sykes, R.M. (Ohio State Univ., Columbus (USA). Dept. of Civil Engineering). Nov 1980. Contract AC02-80CS24310. 13p. NTIS, PC A02/MF A01.

Progress is reported on digester operation for the quarter ending September 1980. Gas production data is included. At present, the experimental digester (not heat added) is operating at an SRT of about 17 days and a temperature of 78°F and is performing about the same as the control units operating at an SRT of 10 days and a temperature of 94°T. (DMC)

16604 **(DOE/ER/04900—1) Studies of the hydrogenation of small unsaturated molecules using organometallic cluster compounds as catalysts.** (Yale Univ., New Haven, CT (USA)). 1981. Contract AS02-78ER04900. 20p. NTIS, PC A02/MF A01.

Progress under contract DE-AC02-78ER04900 and plans for continued investigations of the reactivity of transition metal hydride cluster compounds with small heteronuclear unsaturated molecules are described. Research will include further elucidation of the mechanisms of hydrogen transfer from metal atoms to unsaturated substrates and studies of the structure and bonding of partially hydrogenated substrates coordinated to polynuclear metal centers. Investigations of the reactivity of the bridging hydride ligand and the chemistry of alkyl groups in clusters are planned. The development of heteronuclear clusters as homogeneous CO hydrogenation catalysts will be attempted.

16605 **(DOE/ET/20050—T4) Liquid fuels production from biomass. Final report.** Levy, P.F.; Sanderson, J.E.; Ashare, E.; Wise, D.L.; Molyneaux, M.S. (Dynatech R/D Co., Cambridge, MA (USA)). 30 Jun 1980. Contract AC02-77ET20050. 126p. NTIS, PC A07/MF A01.

The current program to convert biomass into liquid hydrocarbon fuels is an extension of a previous program to ferment marine algae to acetic acid. In that study it was found that marine algae could be converted to higher aliphatic organic acids and that these acids could be readily removed from the fermentation broth by membrane or liquid-liquid extraction. It was then proposed to convert these higher organic acids via Kolbe electrolysis to aliphatic hydrocarbons, which may be used as a diesel fuel. The specific goals for the current porgram are: (1) establish conditions under which substrates other than marine algae may be converted in good yield to organic acids, here the primary task is methane suppression; (2) modify the current 300-liter fixed packed bed batch fermenter to operate in a continuous mode; (3) change from membrane extraction of organic acids to liquid-liquid extraction; (4) optimize the energy balance of the electrolytic oxidation process, the primary task is to reduce the working potential required for the electrolysis while maintaining an adequate current density; (5) scale the entire process up to match the output of the 300 liter fermenter; and (6) design pilot plant and commercial size plant (1000 tons/day) processes for converting biomass to liquid hydrocarbon fuels and perform an economic analysis for the 1000 ton/day design.

16606 **(LBL—12331) Liquefaction of Douglas Fir wood slurries: titration of acids and anions in aqueous product and feed slurries.** Davis, H.G. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01.

After hydrolytic pretreatment, wood slurries contain substantial amounts of organic acids. Additional acids are produced during the liquefaction step whether or not there is prehydrolysis. The acids have pH's in the range of about 3 to 5 and are easily titrated potentiometrically with sodium hydroxide. Anions present in neutralized slurry or in aqueous product can be titrated with hydrogen chloride solution with appropriate corrections for sulfate if present, and for excess titrant at the low pH of the endpoint.

16607 (TR—80/031-001, pp 127-144) **Peat gasification: IGT work progress.** Punwani, D.V. (Inst. of Gas Tech., Chicago, IL). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

Twenty-eight laboratory-scale tests were conducted in an entrained flow hydrogasification reactor, and 80 tests were conducted to evaluate the gasification characteristics of the chars from Minnesota, North Carolina, and Maine peats. Fluidization, grinding, and slurrying characteristics tests established that peat can be fluidized once it has been ground and screened to the right size. From the laboratory-scale tests, IGT progressed to the larger PDU tests. From the PDU-scale tests more can be learned about product yields, especially the liquids produced during hydrogasification, and better information can be obtained on material balances. IGT also ran 35 tests on converting peat char to synthesis gas in a fluidized-bed gasifier at high temperature and pressure. These tests were conducted using the same methods as those used successfully in coal-gasification tests. Kinetic models were developed that can be used to scale up the data to larger-scale gasifiers. Finally, an evaluation of the process economics of peat conversion to SNG showed that it is competitive with the alternative processes for making SNG. Discussed are some of the characteristics of peat that make it a valuable raw material for gasification, as well as other peat characteristics important for producing synthetic fuels.

16608 (TR—80/031-001, pp 145-165) **Peat pretreatment: high-pressure wet carbonization.** Punwani, D.V. (Inst. of Gas Tech., Chicago, IL). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

Wet carbonization involves the heating of wet peat under pressure. During wet carbonization, decarboxylation and dehydrolization reactions take place. These reactions improve the mechanical dewaterability and heating value of the solids. It is a pretreatment that allows mechanical dewatering to reduce the moisture content to a range of 35 to 50%. The wet carbonization process improves the heating value by deoxygenating the material. The reduced oxygen content of the peat helps improve its heating value. Minnegasco, DOE, and GRI have started to investigate wet carbonization. The objective of the program is to determine the effects of a wide range of operating conditions: temperatures from 300 to 600°F, pressures from 300 to 2000 psig, and residence times of up to 80 minutes. The wet carbonization program has been divided into five subtasks: (1) wet carbonization tests; (2) mechanical dewatering of the wet carbonized peat; (3) hydrogasification of the wet carbonized peat; (4) char gasification; and (5) evaluation of the process economics. Progress in each of these areas is reported.

16609 (TR—80/031-001, pp 167-181) **Peat dewatering: solvent extraction.** Punwani, D.V. (Inst. of Gas Tech., Chicago, IL). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

IGT is also investigating solvent extraction dewatering. Solvent extraction is based on the principle that there are certain solvents whose water solubility changes significantly with temperature. At high temperatures, solvents can dissolve more water, and at low temperatures, the solubility decreases. At cool temperatures the solvent and water separate and the water and organic solvents can be decanted easily. The advantages of this process is that large amounts of heat are not required, thus water vaporization is avoided. It is very heat-efficient. Its disadvantage is increased cost because of the heat exchange equipment and solvent pumps required. Determining the technical and economic feasibility of the concept is the objective of the dewatering program. The first task is to identify those potential solvents with desirable water solubility characteristics. Then, design and construct small bench-scale equipment to obtain some experimental results, select the preferred solvent, put together a complete process design, and estimate its preliminary economics.

16610 (TR—80/031-001, pp 183-193) **Peat gasification: low-severity hydropyrolysis.** Punwani, D.V. (Inst. of Gas Tech., Chicago, IL). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

The final task performed by IGT was testing of low-severity hydropyrolysis. Low severity means temperatures below 1500°F, pressures below 500 psig, and residence times of one second or more. Work at temperatures and pressures higher than these is being done by Rockwell. The equipment used for the IGT tests is described. For those tests conducted as a part of the hydrogasification work, the liquid product from the peat hydrogasification tests was compared with that from lignite hydrogasification tests. On the basis of chemistry and kinetics, it looks as though peat is a better material for making synthetic fuels than coal. It is important to examine in more detail the effect of temperatures and pressures on the quantity and quality of the liquids produced.

16611 (TR—80/031-001, pp 195-222) **Peat gasification: Rockwell International process.** Friedman, J. (Rockwell International, Canoga Park, CA). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

The following are the objectives of the Rockwell gasification program: to extend the data base to lower hydrogen and peat ratios; to measure the maximum moisture content of the peat at which it can still flow into the reactor in dense-phase fashion; to construct a kinetic model of the process; to develop engineering data for the peat dense-phase flow; to develop parametric engineering information for the moisture content; to obtain pressure drop versus flow rates; and to make preliminary process design studies that exploit the special properties of peat that could make it a more economical process. Rockwell is developing a peat hydrogasification process with a very simple, compact reactor, that requires no large oxygasifier reactors. By utilizing high carbon conversions under somewhat more severe conditions, a significant amount of benzene will be produced which will reduce the price of the SNG.

16612 (TR—80/031-001, pp 247-270) **Modeling in peat gasification.** Arbesman, R.W. (UOP Process Div., Des Plaines, IL). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

This presentation will summarize briefly the progress made to date on one small aspect of the overall gasification development area. The UOP/SDC Joint Venture is investigating the best possible gasifier configuration to be utilized in a planned DOE peat gasification pilot plant. The Joint Venture will make this recommendation to DOE based on a review of available peat gasification technology and an assessment of the applicability of coal gasification technology. The presentation today will be concerned only with the application of fundamental chemical reaction engineering principles to existing peat gasification kinetic information and explain how it has been used to prepare an independent computer model to describe proposed gasification reactor configurations. The entrained solids reactor will be modeled as a plug flow reactor based on the high gas superficial velocities expected in the commercial gasifier. The fluidized-bed reactor model will examine the dense phase or bed, only modeling it as a modified stirred tank reactor with the solid phase completely backmixed and the gas phase in plug flow. Ideally, a computer program written to describe any aspect of the peat gasification process should contain peat composition as an independent variable. Because a great deal of experimentation had been completed on Minnesota peat and the limited time for this study, it was decided to concentrate on Minnesota peat only. Although work has progressed on all aspects of the modeling program, this presentation will focus only on indirect gasification of peat, hydrogasification.

16613 (TR—80/031-001, pp 271-286) **Peat biogasification.** Buivid, M.G. (Dynatech Corp., Cambridge, MA). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

The overall objectives of the program are to develop a process for the conversion of peat to substitute natural gas (SNG) and to evaluate the economics of the process. The peat biogasification process will convert wet peat (greater than 70% moisture) to SNG by the pretreatment of peat to produce water-soluble substances and subsequent conventional anaerobic fermentation of the solubilized matter to produce methane. Experimental work to date has been based on Minnesota reed sedge peat exclusively. Results are summarized. The objective of the continued peat biogasification development program is to obtain necessary information to design and operate a process development unit (PDU).

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 16648, 16649, 16650, 16653, 16654, 16658, 16664, 17076, 17355

16614 **(DOE/ET/20030—1) Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979.** (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nutrition and Food Science). 1979. Contract AS02-77ET20030. 761p. NTIS, PC A99/MF A01.

This is a coordinated program to effect the microbiological degradation of cellulosic biomasses and will focus on the use of anaerobic microorganisms which possess cellulolytic enzyme. The studies will attempt to increase the enzyme levels through genetics, mutation and strain selection. In addition, the direct conversion from cellulosic biomasses to liquid fuel (ethanol) and/or soluble sugars by the cellulolytic, anaerobic organism is also within the scope of this program. Process and engineering scale-up, along with economic analyses, will be performed throughout the course of the program. The second area of our major effort is devoted to the

production of chemical feedstocks. In particular, three fermentations have been identified for exploration. These are: acrylic acid, acetone/butanol and acetic acid. The main efforts in these fermentations will address means for the reduction of the cost of manufacturing for these large volume chemicals.

16615 (LBL—11650, pp 4.1-4.39) **Chemical Process Research and Development Program.** Oct 1980.

In Energy and Environment Division annual report, 1979.

The following are reported: process development for bioconversion of cellulose and production of alcohol; low-cost, low-energy flash ethanol fermentation; studies of physiology and enzymology of lignin degradation; biomass liquefaction; pretreatment of biomass prior to liquefaction; catalytic liquefaction of biomass; monitoring of the biomass liquefaction PDU at Albany, Oregon; LBL continuous biomass liquefaction process engineering unit (PEU); selective hydrogenation of coal; coal desulfurization; processing of condensate waters from solid-fuel conversion; applied battery and electrochemical research program; and battery electrode studies. (DLC)

16616 **(PB—80-212236) Solubilities of acid gases and nitrogen in methanol. Final report, September 1979-April 1980.** Ferrell, J.K.; Rousseau, R.W.; Matange, J.N. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). May 1980. 88p. NTIS, PC A05/MF A01.

The report describes a thermodynamic model, developed to predict the equilibrium behavior of carbon dioxide, hydrogen sulfide, nitrogen, and methanol mixtures. The model uses the four-suffix Margules equation to describe liquid-phase nonidealities and the Soave modification of the Redlich-Kwong equation of state to describe the gas phase. Model parameters were obtained from previously published binary vapor/liquid equilibrium data. Vapor/liquid equilibrium data were obtained experimentally for CO2/H2S/N2/methanol mixtures at temperature and liquid compositions compared favorably with experimentally measured values.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 16638, 16664, 16996, 17241, 17362

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 16939

1301 Resources And Availability

16617 **(DOE/R9/10031—T1) Hydroelectric power in Hawaii. A report on the statewide survey of potential hydroelectric sites.** Beck, C.A. (Hirai (W.A.) and Associates, Inc., Hilo, HI (USA)). Feb 1981. Contract FC49-80R910031. 107p. NTIS, PC A06/MF A01.

An assessment was made of the hydropower potential in Hawaii. The major conclusion of this study is that hydropower resources in the State of Hawaii are substantial, and they offer the potential for major increases in hydropower generating capacity. Hydropower resources on all islands total about 50 MW of potential generating capacity. Combined with the 18 MW of existing hydropower capacity, hydropower resources potentially could generate about 307 million kWh of electric energy annually. This represents about 28% of the present combined electricity needs of the Neighbor Islands, Kauai, Molokai, Maui, and the Big Island. Hydropower resources on Kauai equal 72% of that island's electricity needs; on Molokai, 40%, on the Big Island, 20%; and on Maui, 18%. The island of Oahu, however, has only small hydropower resources, and could only generate a negligible portion of its electricity needs from this energy source. A summary of existing and future (potential) hydropower capacities and estimated annual outputs for each island is presented. How much of the potential capacity is being actively considered for development and how much is only tentatively proposed at the time is indicated. The economics of hydropower at specific sites were analyzed. The major conclusion of this analysis is that hydropower development costs vary widely among the different sites, but that generally the cost of hydroelectric power is either less than or comparable to the cost of oil-fired power.

16618 **(FERC—0066) Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Jan 1981. 90p. NTIS, PC A05/MF A01.

The water resources of the Little Tennessee River Basin which covers 2627 sq. miles in parts of Tennessee, Georgia and North Carolina, are evaluated for potential hydropower development. Information is included on: the economy of the Basin; existing water and related land resources; the East Fork, West Fork, and Nantahala Projects which are under major license consideration; and future water developments. It is concluded that the three planned projects are economically justified and environmentally sound. In addition potential developments which have not been evaluated for feasibility could produce approximately 4600 MW in hydropower. (LCL)

16619 **(FERC—0072) Water resources appraisal for hydroelectric licensing: Elwha River Basin, Washington. Appraisal report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Mar 1981. 45p. NTIS, PC A03/MF A01.

The water resources of the Elwha River Basin, a 321 sq. mile area on the Olympic Peninsula in Washington state are evaluated for potential hydropower development. Information is included on the climate, topography, economy, demography, and existing water and related land resources development in the Basin, on the Glines Canyon and Elwha hydroelectric projects, and future development and uses of water resources in the area. (LCL)

16620 **(FERC—0073) Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Mar 1981. 18p. NTIS, PC A02/MF A01.

The hydroelectric power potential of water resources in the Santee River Basin area in North and South Carolina is evaluated. This 17,400 mi^2 area includes the drainage systems of the Santee, Cooper and Ashley Rivers. Data are included on existing and potential water resource developments and on water use by existing and projected steam-electric generating facilities. Past and current planning studies are summarized. The information is current as of December 1980. (LCL)

16621 **(FERC—0074) Water resources appraisals for hydroelectric licensing: Tennessee River Basin, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, and Alabama. Planning status report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Mar 1981. 16p. NTIS, PC A02/MF A01.

The hydroelectric power potential of the Tennessee River Basin which covers portions of Virginia, North Carolina, Tennessee, Alabama, Georgia, and Kentucky is evaluated. Data are presented on existing and potential water resource developments, on water use by existing and projected steam-electric generating plants, and on the status of hydro plant licensing. Past and current planning studies are summarized. The information is current as of December 1980.

16622 **(FERC—0075) Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Feb 1981. 20p. NTIS, PC A02/MF A01.

Data are presented on the water resources of the Savannah and Edisto River basins area which, with the intervening coastal area, covers 15,982 sq mi. This report provides updated information on water resources for use by the Federal Energy Regulatory Commission and its staff when considering hydroelectric licensing

and other work. The report presents data on water resource developments, existing and potential, and on water use by existing and projected steam-electric generating facilities. The report also summarizes past and current planning studies. The information presented in these reports was abstracted from available sources and involved no new analyses. Information is current as of December 1980 unless otherwise indicated. (LCL)

16623 **(FERC—0076) Water resources appraisals for hydroelectric licensing: American River Basin, California. Planning status report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Mar 1981. 19p. NTIS, PC A02/MF A01.

The hydroelectric power potential of water resources in the American River Basin which covers 2160 sq. miles in California is evaluated. Data are presented on existing and potential water resource development, on water use by existing and projected steam-electric facilities, and the status of hydroplant licensing. Past and current planning studies are summarized. The information is current as of December 1980. (LCL)

16624 **(FERC—0077) Water resources appraisals for hydroelectric licensing: Cumberland River Basin, Kentucky and Tennessee. Planning status report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Feb 1981. 20p. NTIS, PC A02/MF A01.

The water resources of the Cumberland River Basin which covers 17,914 sq. miles in southern Kentucky and north central Tennessee are evaluated. Data are presented on existing and potential water resource development, on water use by existing and projected steam-electric generating facilities, and the status of hydroplant licensing. Past and current planning studies are summarized. The information is current as of December 1980. (LCL)

16625 **(FERC—0078) Water resources appraisals for hydroelectric licensing: Tombigbee-Warrior River Basin, Alabama and Mississippi. Planning status report.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Feb 1981. 19p. NTIS, PC A02/MF A01.

The water resources of the Tombigbee-Warrior River Basin which covers approximately 22,000 sq. miles in Alabama and Mississippi are evaluated for hydropower potential. Information is included on existing and potential water resource developments, on water use by existing and projected steam-electric power plants, past and current planning studies and the status of power plant licensing. This information is current as of December 1980. (LCL)

16626 **(FERC—0079) Planning status report. Water resources appraisals for hydroelectric licensing: Colorado River Basin, Texas.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). Feb 1981. 18p. NTIS, PC A02/MF A01.

The water resources of the Colorado River Basin, a 41,763 sq mile area in New Mexico and Texas, are evaluated for hydro power potential. Data are presented on existing and potential water resource development, cooling water requirements existing steam-electric power plants, the status of hydro plant licensing, and past and current water resource planning studies. The information is current as of December 1980.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 16787, 16927

1304 Regulations And Licensing

REFER ALSO TO CITATION(S) 16622

1305 Economics And Management

REFER ALSO TO CITATION(S) 16592

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 16939, 17355

16627 **(LBL—11650, pp 3.1-3.44) Solar energy program.** Oct 1980.

In Energy and Environment Division annual report, 1979.

Progress is reported in the following areas: (1) ultrafine particle suspensions for solar energy collection, (2) sensible heat storage for a solar thermal power plant, (3) passive systems analysis and design, (4) Nitinol engine development, (5) appropriate energy technology, (6) energy conversion by halobacteria, (7) solar heated gas turbine process using sulfur oxides for power production and energy storage, (8) evaluation of control strategies for active solar energy systems, (9) solar driven absorption air conditioners, (10) passive cooling, (11) LBL Solar Demonstration Project in Building 90, (12) support for commercial solar demonstration programs, (13) measurement and analysis of circumsolar radiation, (14) instrumentation and data processing modifications in the PG and E/LBL Solar Data Network, and (15) support activities for DOE Solar Heating and Cooling Research and Development Program. (WHK)

16628 **(SERI/TR—751-753) General solar energy information user study.** Belew, W.W.; Wood, B.L.; Marle, T.L.; Reinhardt, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 237p. NTIS, PC A11/MF A01.

This report describes the results of a series of telephone interviews with groups of users of information on general solar energy. These results, part of a larger study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. The report is 1 of 10 discussing study results. The overall study provides baseline data about information needs in the solar community. An earlier study identified the information user groups in the solar community and the priority (to accelerate solar energy commercialization) of getting information to each group. In the current study only high-priority groups were examined. Results from 13 groups of respondents are analyzed in this report: Loan Officers, Real Estate Appraisers, Tax Assessors, Insurers, Lawyers, Utility Representatives, Public Interest Group Representatives, Information and Agricultural Representatives, Public Interest Group Representatives, Information and Agricultural Specialists at State Cooperative Extension Service Offices, and State Energy Office Representatives. The data will be used as input to the determination of information products and services the Solar Energy Research Institute, the Solar Energy Information Data Bank Network, and the entire information outreach community should be preparing and disseminating.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 16688

1403 Economics

REFER ALSO TO CITATION(S) 16689, 16691, 16692

16629 **(ANL-K—80-63) Economic analysis of residential combined solar-heating and hot-water systems.** (Mueller Associates, Inc., Baltimore, MD (USA)). 23 Sep 1980. Contract W-31-109-ENG-38. 79p. NTIS, PC A05/MF A01.

A brief description of a typical residential solar heating and hot water system and typical cost and performance information are presented. The monthly costs and savings of the typical system are discussed. The economic evaluation of solar residential systems is presented in increasing levels of complexity. Utilizing a typical system, the effective interest rate that the purchaser of a system would receive on money invested is shown for all regions of the country. The importance of numerous variables that can make a

significant difference on the economics of the system is described so that it can be determined whether the typical system economics are compatible with the particular situation. Methods for calculating the payback period for any non-typical solar system are described. This calculated payback period is then shown to be related to the effective interest rate that the purchaser of the system would receive for a typical economic condition. A nomagraph is presented that performs this calculation. Finally, a method is presented to calculate the effective interest rate that the solar system would provide. It is shown how to develop the relationship between payback period and the effective interest rate for any economic scenario.

16630 **(SERI/TR—633-1063) Solar thermal cost goals.** Edelstein, R.B. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1981. Contract AC02-77CH00178. 9p. (CONF-810405—13). NTIS, PC A02/MF A01.

From 3. annual systems simulation, economic analysis/solar heating and cooling operational results conference; Reno, NV, USA (27 Apr 1981).

Setting of goals for a research, development, and demonstration program is critical in measuring its progress and ensuring its success. The development of cost goals for the DOE Solar Thermal Program by the Solar Thermal Cost Goals Committee (STCGC), led by the Solar Energy Research Institute, is described. The objective of the STCGC is to determine a consistent set of time-related cost and performance goals for concentrating collector systems based on market value and intermediate goals based on attainable cost levels. Accomplishments thus far include: definition of cost goals and their function in program planning, delineation of competing energy systems costs, development of a breakeven costing methodology for assessing market value, determination of attainable costs for solar thermal systems, setting financial and economic parameters, and calculation of market value as a function of each competing fuel type, application, and region.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 16686, 16697, 16700

16631 **(BNL—51324) Estimates of occupational safety and health impacts resulting from large-scale production of major photovoltaic technologies.** Owens, T.; Ungers, L.; Briggs, T. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems; PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Aug 1980. Contract AC02-76CH00016. 101p. NTIS, PC A06/MF A01.

The purpose of this study is to estimate both quantitatively and qualitatively, the worker and societal risks attributable to four photovoltaic cell (solar cell) production processes. Quantitative risk values were determined by use of statistics from the California semiconductor industry. The qualitative risk assessment was performed using a variety of both governmental and private sources of data. The occupational health statistics derived from the semiconductor industry were used to predict injury and fatality levels associated with photovoltaic cell manufacturing. The use of these statistics to characterize the two silicon processes described herein is defensible from the standpoint that many of the same process steps and materials are used in both the semiconductor and photovoltaic industries. These health statistics are less applicable to the gallium arsenide and cadmium sulfide manufacturing processes, primarily because of differences in the materials utilized. Although such differences tend to discourage any absolute comparisons among the four photovoltaic cell production processes, certain relative comparisons are warranted. To facilitate a risk comparison of the four processes, the number and severity of process-related chemical hazards were assessed. This qualitative hazard assessment addresses both the relative toxicity and the exposure potential of substances in the workplace. In addition to the worker-related hazards, estimates of process-related emissions and wastes are also provided.

16632 **(CONF-7910187—(Suppl.)) Department of Energy responses to panel recommendations from the open workshop on solar technologies.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Conservation and Solar Energy). Jul 1980. 128p. NTIS, PC A07/MF A01.

From Open workshop on solar technologies; Washington, DC, USA (23 Oct 1979).

This document is a companion to the Proceedings of the Open Workshop on Solar Technologies, 23 and 24 October 1979, Washington, DC. That document reported the findings and conclusions of six panels on the policies of the Department of Energy (DOE) on solar energy and its relationships to cities and employment. The present document provides DOE responses to each panel's recommendations. Sixty individuals from a wide variety of backgrounds agreed to take part in the deliberations of the six panels. There were three panels on solar energy in the cities and three on solar energy and employment. A significant portion of the participants represented public interest groups; lesser numbers were from government and industry. Interested persons were publicly invited to observe. About 120 additional persons responded, bringing the total to 180 participants. Appendices include: (1) a selected guide to federal energy and education assistance; (2) resources for community energy programs and community energy assistance, by state; and (3) summary and data on federal energy education, extension, and information activities. (WHK)

16633 **(SERI/TP—731-1128) Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications.** Gresham, J.B.; Kriz, T.A. (Solar Energy Research Inst., Golden, CO (USA); Science Applications, Inc., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 12p. (CONF-810315—9). NTIS, PC A02/MF A01.

From 8. energy technology conference and exposition; Washington, DC, USA (9 Mar 1981).

To achieve widespready application in the industrial and utility sectors, solar systems must be economically competitive. Economic viability is, in turn, determined by a number of supporting criteria, ranging from system reliability to dispatch characteristics to how the system supports the main product line. In addition, solar systems possess some inherent attributes that may render some of the traditional supporting criteria inappropriate or require their redefinition. Those criteria and their relation to the solar investments are discussed in three steps. First, the main concerns and preferences of the potential users, as identified in recent SERI studies, are identified. Second, the equitability of the resulting decision criteria for solar investments are examined. Finally, the implications of these criteria for solar energy's penetration into these markets are discussed.

16634 **(UCLA—12-1281) Vegetation management and recovery at sites distrubed for solar thermal power systems development. Progress report for FY 1980.** Romney, E.M.; Hunter, R.B.; Wallace, A. (California Univ., Los Angeles (USA). Lab. of Biomedical and Environmental Sciences). Feb 1981. Contract AC03-76SF00012. 25p. NTIS, PC A02/MF A01.

Disturbing land to develop energy producing technologies in Mojave Desert areas usually destroys existing shrub vegetation that cannot be repaired by natural restoration processes within the time frame requried by environmental protection legislation. Such is the case, especially, for central receiver solar thermal power systems which perturb large areas of land. Once the natural vegetation is destroyed, the denuded land is more vulnerable to water and wind erosion, and the subsequent dust-prone environment generally becomes a nuisance to construction engineers and installation operators. The primary effort of the vegetation management project during FY 1980 was directed toward the development of cost effective methods of restoring native vegetation on disturbed Mojave Desert land. Emphasis was placed upon improving techniques for producing transplanting stocks of native shrub species, investigating different ways to protect and encourage regrowth from crown sprouting and new seedling germination, developing improved transplanting methods, and searching for more practical means of conserving seasonal soil moisture necessary for the survival of new plant seedlings and transplanted specimens. An overall project goal is to develop methods of restoring native vegetation on disturbed Mojave Desert land within a two or three year time frame in order to provide engineers with a useful tool to combat disturbed site erosion and fugitive dust problems.

16635 **(UCLA—12/1282) Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment.** (California Univ., Los Angeles (USA)). Feb 1981. Contract AC03-76SF00012. 176p. NTIS, PC A09/MF A01.

The purpose of this study was to identify environmental concerns and uncertainties unique to siting a solar-coal hybrid power plant. A conceptual design for such a plant prepared by Rockwell International was arbitrarily chosen as a representative technology. A location selected for the one-time proposed Sundesert Nuclear Power Plant was chosen as the study site because of its desert location, level of insolation, and the availability of extensive environmental assessment documentation prepared in anticipation of developing the Sundesert facility. Environmental concerns were examined in the perspective of the facility's impact on the environment; the environment's impact on the facility; and intraplant impacts arising from the interaction of subsystems. This study identified several impact categories as significant but common to any type of power plant that might be constructed at the site (e.g., water supply, vegetation and wildlife, and socioeconomics). The effect of the facility on the environment was dominated by the large area of land required which in turn produced significant environmental concerns in the areas of air quality, geology, hydrology, vegetation and wildlife, and aesthetics. Health and safety concerns unique to solar were associated primarily with fluid releases and misdirected heliostat reflections. The effect of the environment on the facility was dominated by air quality concerns which also dominated solar-hybrid subsystem interactions. Emissions from coal combustion and coal handling were viewed as significant problems which could compromise the efficiency of the facility.

16636 **(UCLA—12/1283) Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts.** Hunsaker, D.B. Jr.; Hunsaker, C.T.; Perrine, R.L. (California Univ., Los Angeles (USA)). Feb 1981. Contract AC03-76SF00012. 102p. NTIS, PC A06/MF A01.

A study to identify environmental constraints to siting a conceptual solar/coal hybrid power plant revealed that air quality and meteorological considerations, both off-site and on-site were likely to impact both land-use requirements and plant operations (Vol. I). This volume presents a more detailed treatment of these concerns including assumptions and methods of analysis. It was found that the hybrid plant was not likely to significantly affect either local or regional climate. Microclimatological effects would probably occur within and near the facility but the effects were not quantified. For worst-case scenarios, as much as several hundred grams of particulate matter from coal combustion might deposit on a single heliostat in a 30-day period. Salt particles deposited from cooling tower operation and off-site fugitive dust sources (including crop dusting) could add comparable amounts under their respective worst-case scenarios. Natural and fugitive emissions from coal handling could also deposit significant but unquantified amounts of matter. Thus, a worst-case estimate would be that as much as kilogram quantities of matter could be deposited per heliostat in a 30-day period. The implications of these findings are presented along with recommendations for studies to resolve the uncertainties inherent in the assumptions made for the purposes of this study.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 16593, 16606, 16614, 16615, 16681, 16681, 17076, 17186, 17465, 17467

16637 **(BNL—29160) Study of gap states in a-Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells.** Vanier, P.E.; Delahoy, A.E.; Griffith, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 7p. (CONF-810331—1). NTIS, PC A02/MF A01.

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

A picture of the density of gap states n(E) in glow discharge a-Si:H is constructed using four different kinds of transport measurement on a large number of samples. The minimum in n(E) lies 0.4 eV below E/sub c/, rather than in the middle of the gap. A distribution of fast recombination centers lies at mid-gap, and two sets of hole traps lie between mid-gap and the valence band. Modifications in n(E) have been studied by the effects of selected impurities on the conversion efficiency and spectral response of MIS and p-i-n solar cells.

16638 **(BNL—51196) Issues in the use of wood as an energy source in the northeastern US.** Munson, J.S. (ed.). (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). May 1980. Contract AC02-76CH00016. 129p. NTIS, PC A07/MF A01.

This report analyzes some of the concerns surrounding the use of wood for energy in the Northeast. It reviews the information on resource availability and ownership patterns in the Northeast, then focuses on New England, to assess the affect of potential resource constraints on the supply of wood available for energy and the effects of wood energy use on land use patterns. Finally, the application of specific technologies in settings that may experience significant wood energy use in the future is considered, including an assessment of the regional employment and income benefits of a major woodfuel installation.

16639 **(DOE/ER/04475—2) Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980.** (Illinois Univ., Urbana (USA)). Sep 1980. Contract AS02-77ER04475. 7p. NTIS, PC A02/MF A01.

Methodology has been developed for the isolation and characterization of pigment-proteins from chloroplast membranes. Characterization of these pigment-proteins has increased our understanding of mechanisms regulating the efficiency of photosynthetic light harvesting during photosynthesis. Incorporation of isolated pigment-protein complexes into model membranes has allowed simulation of grana stacks; these structural features of chloroplasts play a key role in maintaining appropriate interactions among light-harvesting assembles to regulate photosynthetic solar energy conversion.

16640 **(DOE/ER/04927—T4) Environmental effects on electron transfer from chlorophyll triplet to quinone: role of dielectric constant, viscosity and quinone structure in cellulose acetate films.** Cheddar, G.; Tollin, G. (Arizona Univ., Tucson (USA)). 1981. Contract AS02-78ER04927. 17p. NTIS, PC A02/MF A01.

The effects of environmental parameters on chlorophyll triplet quenching and electron transfer to quinones have been investigated in a system consisting of donor and acceptor incorporated into a cellulose acetate film which was subsequently exposed to solvent. Triplet quenching by a diffusional mechanism was found to occur in the dry film, with steric effects being a major determinant of quencher effectiveness. No formation of separated radicals was found under these conditions, probably because the high viscosity prevented separation of the initially formed radical-ion pair. When the film was subsequently exposed to water, triplet quenching became more effective and separated radical production occurred. This is attributed to effects of decreased microviscosity and increased dielectric constant. Both steric effects and quinone redox potential were found to influence radical yields. Rate constants for reverse electron transfer were independent of quinone redox potential. When solvents other than pure water were used, radical yields were observed to increase with the dielectric constant. This is ascribed to an increase in the ease of separation of the radical-ion pair.

16641 **(DOE/ET/23003—3) Emerging material systems for solar-cell applications. Technical progress report No. 3, 17 October 1979-16 January 1980.** Biter, W.J.; Szedon, J.R. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 23 Jul 1980. Contract AC02-79ET23003. 20p. NTIS, PC A02/MF A01.

Progress is reported on a program to develop an InP/CdS polycrystalline thin film solar cell. The plasma deposition system was completed and a number of depositions of InP were made with the indium transported into the reaction zone via the vapor phase transport of indium chloride. Amorphous film of InP were obtained when the substrate was at room temperature. Substrate tempera-

tures above approximately 200°C resulted in polycrystalline films. Junctions were formed in n-type InP by diffusion of Cd using a sealed tube technique. (WHK)

16642 **(DOE/ET/23036—4) Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980.** Paul, W. (Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). Oct 1980. Contract AC03-79ET23036. 51p. NTIS, PC A04/MF A01.

Alloys of GaAs with hydrogen have been prepared both by rf sputtering in argon and by glow discharge decomposition of mixtures of AsH_3 and $Ga(CH_3)_3$. Many deposition parameters have been systematically varied: argon pressure, hydrogen pressure, substrate temperature, and sputtering rf power. Among the characterizational methods employed have been x-ray diffraction, transmission and scanning electron microscopy, electron microprobe, secondary ion mass spectrometry, and hydrogen evolution. The properties measured, usually on co-deposited samples, included conductivity and thermopower as a function of temperature, optical absorption edge, vibrational optical absorption in the infrared, Raman scattering, electron spin resonance and photoconductivity. Samples constructed in Schottky barrier configurations were also studied and capacitance-voltage, field effect and photoluminescence experiments carried out. The possibility of doping with Si, and of temperature stabilization by various means was explored. Finally, the production of many samples over the wide variety of preparational conditions, their fundamental properties as indicated, and the usual device studies were evaluated in toto in order to assess the present potential of a-GaAs:H for solar cells. It was concluded that this material probably shares with other hydrogenated binary compounds the fundamental flaw that, despite clear signs of the effects of hydrogen in reducing the density of gap states, there still remains too high a density for viable devices to emerge. Suggestions are made for new studies likely to clarify the present difficulties.

16643 **(DOE/ET/23037—1) Determination of PSEUDO-GAP state density and carrier mobility in r.f. sputtered amorphous silicon. Quarterly technical progress report, July 1, 1979-September 30, 1979.** Paul, W. (Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences). Oct 1979. Contract AC03-79ET23037. 21p. NTIS, PC A02/MF A01.

Apparatus has been designed and assembled to perform field effect measurements using two different sample configurations. Preliminary measurements indicate that the field effect response is smaller than expected in view of the results quoted by other workers on silane-derived a-Si:H and the overall similarity in other optoelectronic properties. Some inconsistency has been observed between nominally identical samples, which may be related either to uncontrolled variables of our deposition process or to some unknown impurities present. Computer programs have been developed to analyze the ray data and derive a density of states versus energy. Using the data obtained so far, we have studied the effect of the assumed potential distribution inside the semiconductor and of the choice of the flat band voltage V/sub FB/ on the derived density of states. The equipment for the measurement of the time of flight drift mobility has been ordered but has not yet arrived.

16644 **(DOE/ET/23106—4) Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980.** Temofonte, T.A.; Szedon, J.R.; Dickey, H.C.; Biter, W.J.; Fonash, S.J.; Ashok, S.; Lester, P.A. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 16 Feb 1981. Contract AC01-79ET23106. 109p. NTIS, PC A06/MF A01.

The overall goal of this program is to elucidate fundamental aspects of grain boundary influences on photocurrent collection and on opposing current mechanisms in polycrystalline silicon cells to allow achievement of at least 10% conversion efficiency at a cost of $0.30/peak watt or less (1975 $). Modeling efforts have resulted in Fourier and Bessel-Fourier series solutions for carrier transport in right cylindrical grains. Consistent differences were observed in the I-V behavior of Al-SiO/sub x/-pSi solar cells depending on the composition of HNO_3:HAc:HF used for chemical surface etching prior to barrier formation. Optimized grid designs were computer modeled for PN junctions, MIS and inversion layer solar cells, and results are discussed. Slices of polysilicon taken in sequence from the cast ingot which have very similar grain structure were identified. These correlated slices have been useful in studies of both chemical etch effects and plasma hydrogenation.

16645 **(DOE/JPL/954331—81/13) Silicon materials task of the Low-Cost Solar Array Project: Phase IV. Effects of impurities and processing on silicon solar cells. Twenty-first quarterly report, October-December 1980.** Hopkins, R.H.; Hanes, M.H.; Davis, J.R.; Rohatgi, A.; Rai-Choudhury, P.; Mollenkopf, H.C. (Westinghouse Research and Development Center, Pittsburgh, PA (USA); Hemlock Semiconductor Corp., MI (USA)). 30 Jan 1981. Contract NAS-7-100-954331. 82p. NTIS, PC A05/MF A01.

The overall objective of this program is to define the effects of impurities, various thermochemical processes, and any impurity-process interactions upon the performance of terrestrial solar cells. The results of the study form a basis for silicon producers, wafer manufacturers, and cell fabricators to develop appropriate cost-benefit relationships for the use of less pure, less costly solar grade silicon. Cr is highly mobile in silicon even at temperatures as low as 600°C. Contrasting with earlier data for Mo, Ti, and V, Cr concentrations vary from place to place in polycrystalline silicon wafers and the electrically-active Cr concentration in the polysilicon is more than an order of magnitude smaller than would be projected from single crystal impurity data. We hypothesize that Cr diffuses during ingot cooldown after groth, preferentially segregates to grain boundaries and becomes electrically deactivated. Both Al and Au introduce deep levels when grown into silicon crystals. Accelerated aging data from Ni-contaminated silicon imply that no significant impurity-induced cell performance reduction should be expected over a twenty-year device lifetime. Combined electrical bias and thermal stressing of silicon solar cells containing Nb, Fe, Cu, Ti, Cr, and Ag, respectively produces no performance loss after 100 hour exposures up to 225°C. Ti and V, but not Mo, can be gettered from polycrystalline silicon by $POCl_3$ or HCl at temperatures of 1000 and 1100°C.

16646 **(DOE/JPL/954373—80/18) Silicon ingot casting - heat exchanger method (HEM); multi-wire slicing - fixed abrasive slicing technique (FAST). Phase IV. Silicon sheet growth development for the Large Area Sheet Task of the Low-Cost Solar Array Project. Quarterly progress report No. 4, October 1-December 31, 1980.** Schmid, F.; Khattak, C.P.; Basaran, M. (Crystal Systems, Inc., Salem, MA (USA)). Feb 1981. Contract NAS-7-100-954373. 45p. NTIS, PC A03/MF A01.

The crystallinity of large-size ingots has been studied as a function of the heat flow conditions at the bottom of the ingot. The size of the ingot has an important effect on crystallinity. The breakdown in crystallinity across the bottom has been resolved to an area in the vicinity of the melted-back seed. Generally, homogeneous resistivity distribution has been achieved all over the ingot. Electroplating of diamonds on one side of the wirepack has an important effect on slicing performance. However, diamond electroplating must be carefully controlled to have a good seat in the grooved rollers. An in-house electroplating facility is now operational. Good performance was achieved with the initial in-house electroplated wirepacks. Projected add-on cost of HEM ingot casting process has been carried out using IPEG analysis. The value that was obtained is $8.65/m^2, well below the allocation of $18.15/m^2 to meet the 1986 goal.

16647 **(DOE/JPL/954852—7) EBIC and HVTEM studies of RTR silicon ribbon.** Cunningham, B.; Strunk, H.; Ast, D. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Apr 1981. Contract NAS-7-100-954852. 17p. NTIS, PC A02/MF A01.

The defect structure of RTR ribbon No. 6-731, run 803 was studied by CTEM, EBIC and HVTEM. Prior to laser recrystallization the defect structure consists of closely spaced twin and grain boundaries. Precipitation of impurities occurs after laser recrystallization. The observation of electrically active defects in EBIC has been correlated with HVTEM studies Pairs of electrically active defects in twin boundaries are due to stacking faults connecting the twin boundaries.

16648 **(DOE/PE/70151—T5) Energy balances in the production and end use of alcohols derived from biomass. A fuels-specific comparative analysis of alternate ethanol production cycles.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Oct 1980. Contract AC01-79PE70151. 135p. NTIS, PC A07/MF A01.

Considerable public interest and debate have been focused on the so-called energy balance issue involved in the conversion of biomass materials into ethanol for fuel use. This report addresses questions of net gains in premium fuels that can be derived from the production and use of ethanol from biomass, and shows that for the US alcohol fuel program, energy balance need not be a concern. Three categories of fuel gain are discussed in the report: (1) Net petroleum gain; (2) Net premium fuel gain (petroleum and natural gas); and (3) Net energy gain (for all fuels). In this study the investment of energy (in the form of premium fuels) in alcohol production includes all investment from cultivating, harvesting, or gathering the feedstock and raw materials, through conversion of the feedstock to alcohol, to the delivery to the end-user. To determine the fuel gains in ethanol production, six cases, encompassing three feedstocks, five process fuels, and three process variations, have been examined. For each case, two end-uses (automotive fuel use and replacement of petrochemical feedstocks) were scrutinized. The end-uses were further divided into three variations in fuel economy and two different routes for production of ethanol from petrochemicals. Energy requirements calculated for the six process cycles accounted for fuels used directly and indirectly in all stages of alcohol production, from agriculture through distribution of product to the end-user. Energy credits were computed for byproducts according to the most appropriate current use.

16649 **Biomass energy enhancement.** Antal, M.J. Jr. Princeton, NJ; Princeton University (1978). 137p. (NP—25343).

Report to the President's Council on Environmental Quality.

Biomass is the only renewable fuel resource available in the USA today. Using technologies described in this report, the resource is large enough to generate between 2 and 22 quads of gaseous fuels yearly. Biomass is one of the least expensive unregulated fuels, selling for $1.20 per million Btu (delivered). Biomass is a better feedstock for conversion to liquid or gaseous fuels than coal, peat or oil shale. In spite of its evident desirability for synthetic fuel production, the biomass energy resource is being used largely for electric power production. To encourage synthetic fuel production from biomass, it is recommended that: all energy carriers be unit priced ($ per million Btu); the price of fuels be deregulated to provide price incentives for the development of alternative fuel sources; tax incentives and loan guarantees for biomass conversion technologies be implemented; state involvement in biomass inventories and environmental impact assessment be encouraged; and the needs of developing countries for fuels from biomass be assessed, and programs developed to meet those needs. The science and technologies of biomass production, conversion, and product utilization are in their infancy. Little is known of the potential for species selection and improvement to increase biomass productivity. The impact large scale utilization of biomass may have on the environment, and the science of thermochemical conversion processes is not well understood. Too little emphasis has been placed on efficient technologies for biomass conversion to useful fuels. Recommendations are included for developing a better understanding of these areas. 100 references.

16650 **(OTA-E—128) Energy from biological processes. Volume II. Technical and environmental analyses.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Sep 1980. 234p. GPO.

This assessment responds to a request by the Senate Committee on Commerce, Science, and Transportation for an evaluation of the energy potential of biomass. This volume presents the technical and environmental analyses on which the conclusions in Volume 1 are based. The biomass resource base includes forestry, agriculture, unconventional biomass, and biomass wastes. The technical, economic, and environmental aspects of developing these resources are presented. Thermochemical conversion, fermentation, and anaerobic digestion technologies are described. Possible end uses for alcohol fuels are presented. The production of chemicals from biomass is considered. Energy balances for alcohol fuels are given. (DMC)

16651 **(P—500-81-002) Analysis of financial incentives for biomass energy. Final report.** Ward, P.F., Smith, K.D., Vann, L.G. Jr.; Alvarez, M. (Young (Arthur) and Co., Sacramento, CA (USA)). Jan 1981. 265p. California Energy Commission, Sacramento.

This analysis is comprised of several sections including: (1) analysis of existing and proposed federal and state incentives for biomass development; (2) review of the existing California biomass industry; (3) evaluation of various generic incentives measures; (4) identification of barriers to biomass development; and (5) detailed descriptions and cost/benefit analyses of incentive measures. Some of the recommendations identified in this report include: (1) utilizing existing federal and state funds for biomass energy; (2) CEC increasing the promotion of the California Pollution Control Finance Authority and the California Alternative Energy Source Finance Authority; (3) streamlining and improving the air quality permit process for biomass energy projects; (4) CEC awarding grants or contracts for statewide, site-specific biomass resource assessments; (5) CEC providing grant or contract funds for the development of a residue harvester for both agricultural and forestry industry use; and (6) advising that the Public Utilities Commission allow utilities a guaranteed rate of return for bioenergy capital investments.

16652 **(PB—80-207939) Increasing the value of straw by fermentation.** Anderson, A.W. (Oregon State Univ., Corvallis (USA). Dept. of Microbiology). 1979. 103p. NTIS, PC A06/MF A01.

Actual and potential uses for straw, currently a major source of waste cellulose, are reviewed. The study covers five principal aspects: (1) problems associated with straw use; (2) direct uses for straw; (3) mechanical conversion; (4) mechanical, chemical, and biological treatments; and (5) chemicals from straw. Investigation reveals that straw is technically suitable as a raw material in the manufacture of paper, fiberboard, oil, gasoline, alcohol, plastics, enzymes, fuel gases, microbial proteins, and many other products. However, straw has serious economic limitations arising from expensive pretreatment requirements. Also, problems of central supply, bulk production, and transportation are very costly. As a livestock feed, straw is limited by its low protein content, unpalatable taste, and poor digestability. A more feasible use of straw involves its hydrolysis to soluble sugars, minerals, and micronutrients. These products can be fortified with nitrogen and used as a substrate for production of a single cell protein, enzymes, alcohol, organic acids, vitamins, and other organic chemicals. The production of enzymes and alcohol already looks promising in today's rapidly changing economy. Large-scale applications of technology capable of converting straw into food and fuels await resolution of unfavorable economic conditions.

16653 **(PB—80-215692) Ethanol: farm and fuel issues.** (Oklahoma Univ., Norman (USA). Dept. of Chemistry). Aug 1980. Contract NAFC-T-17622921. 160p. NTIS, PC A08/MF A01.

The current U.S. and world grain situations are described as well as adjustments which would be likely for fuel production of 1, 2 and 4 billion gallons of ethanol annually in the 1985-86 period. Predicted acreage shifts in corn, soybeans, wheat and the total of seven major crops are shown. The most likely effects on the feed grains markets both here and abroad are discussed. The value of corn for fuel both with and without the gasoline tax exemption is compared to the actual farm price expected if in the base case (1 billion gallons) real corn prices do not rise. In the higher 2 and 4 billion gallon cases, increases in the real cost of corn and its impact on food prices and the CPI are estimated. A theoretical maximum level of ethanol production recognizing market factors is discussed in terms of acreage, yield, corn production and the fuel ethanol available. Agricultural and other policy frameworks are discussed.

16654 **(PNL—3695) Investigations on catalyzed steam gasification of biomass.** Mudge, L.K.; Weber, S.L.; Mitchell, D.H.; Sealock, L.J. Jr.; Robertus, R.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1981. Contract AC06-76RL01830. 162p. NTIS, PC A08/MF A01.

The purpose of the study is to evaluate the technical and economic feasibility of producing specific gas products via the catalytic gasification of biomass. This report presents the results of re-

search conducted from December 1977 to October 1980. The study was comprised of laboratory studies, process development, and economic analyses. The laboratory studies were conducted to develop operating conditions and catalyst systems for generating methane-rich gas, synthesis gases, hydrogen, and carbon monoxide; these studies also developed techniques for catalyst recovery, regeneration, and recycling. A process development unit (PDU) was designed and constructed to evaluate laboratory systems at conditions approximating commercial operations. The economic analyses, performed by Davy McKee, Inc. for PNL, evaluated the feasibility of adapting the wood-to-methane and wood-to-methanol processes to full-scale commercial operations. Plants were designed in the economic analyses to produce fuel-grade methanol from wood and substitute natural gas (SNG) from wood via catalytic gasification with steam.

16655 **(PNL—3710) Evaluation of critical materials in five additional advance design photovoltaic cells.** Smith, S.A.; Watts, R.L.; Martin, P.; Gurwell, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1981. Contract AC06-76RL01830. 137p. NTIS, PC A07/MF A01.

The objective of this study is to identify potential material supply constraints due to the large-scale deployment of five advanced photovoltaic (PV) cell designs, and to suggest strategies to reduce the impacts of these production capacity limitations and potential future material shortages. The Critical Materials Assessment Program (CMAP) screens the designs and their supply chains and identifies potential shortages which might preclude large-scale use of the technologies. The results of the screening of five advanced PV cell designs are presented: (1) indium phosphide/cadmium sulfide, (2) zinc phosphide, (3) cadmium telluride/cadmium sulfide, (4) copper indium selenium, and (5) cadmium selenide photoelectrochemical. Each of these five cells is screened individually assuming that they first come online in 1991, and that 25 Gwe of peak capacity is online by the year 2000. A second computer screening assumes that each cell first comes online in 1991 and that each cell has a 5 GWe of peak capacity by the year 2000, so that the total online capacity for the five cells is 25 GWe. Based on a review of the preliminary baseline screening results, suggestions were made for varying such parameters as the layer thickness, cell production processes, etc. The resulting PV cell characterizations were then screened again by the CMAP computer code. The CMAP methodology used to identify critical materials is described; and detailed characterizations of the advanced photovoltaic cell designs under investigation, descriptions of additional cell production processes, and the results are presented. (WHK)

16656 **(SAND—81-7002) Concentrator-solar-cell development. Final technical report, 27 March 1979-30 March 1980.** Grenon, L. (Motorola, Inc., Phoenix, AZ (USA). Solar Operations). Mar 1981. Contract AC04-76DP00789. 76p. NTIS, PC A05/MF A01.

A program for the continued development of high efficiency silicon concentrator solar cells has been performed. In this program, a critical examination of each process step and the overall process sequence was made. Specific attention was given to the pattern etching and metallization processes, each of which had exhibited the widest degree of variability in earlier programs. Use of reactive ion, R-F plasma etching processes have greatly improved the quality of metal line width and silicon surface quality. A detailed review of the plated metallization requirements has resulted in an improved understanding of this area. Further, areas which require continued work have been identified.

16657 **(SAND—81-7005) Silicon concentrator solar cell development.** (Spire Corp., Bedford, MA (USA)). Mar 1981. Contract AC04-76DP00789. 85p. NTIS, PC A05/MF A01.

The results of a 1-year contract to develop a silicon concentrator solar cell and the manufacturing process to produce the cell are summarized. Discussions include the development of the device design, the development of the manufacturing-process sequence, and the accompanying cost analyses. Several concentrator cell designs were developed that are compatible with cell assemblies using conventional and electrostatically bonded coverglasses. The cell geometries are suitable for 20- to 50-sun line or point focus concentrator optical systems with illuminated areas that are 5 cm wide. The cell design includes a back surface field that is also a back surface reflector in an n^+pp^+ structure. The process sequence required to manufacture the cell is based on ion implantation and pulse annealing for junction and back surface field formation. Contacts for junction and back surface reflectors are processed by conventional photolithography; vacuum evaporation and electroplating of additional silver are required for adequate conduction. Cost analyses for the device and process sequence were performed using the JPL SAMIS III model with production equipment that was available in 1980. The results of the analysis showed that 50-sun concentrator cells can be produced for $0.45 per peak watt or $0.26/cm^2 using $0.075/cm^2 float-zone silicon material (1975$).

16658 **(SERI/CP—622-1086) Tree crops for energy co-production on farms.** (Solar Energy Research Inst., Golden, CO (USA)). 1980. Contract AC02-77CH00178. 241p. (CONF-801172—). NTIS, PC A11/MF A01.

From Tree crops for energy co-production on farms; Estes Park, CO, USA (12 Nov 1980).

This volume contains papers presented at a workshop exploring implications of tree crops for energy production on farms. A summary of the last day's discussion concerning future research, development and demonstration recommendations is included. The appendix contains a computer-search bibliography on tree-crops. Separate abstracts have been prepared for individual papers for inclusion in the Energy Data Base. (DMC)

16659 (SERI/CP—622-1086, pp 97-111) **Chinese tallow tree as a cash and petroleum-substitute crop.** Scheld, H.W. (Simco, Inc., Houston, TX); Bell, N.B.; Cameron, G.N.; Cowles, J.R.; Engler, C.R.; Krikorian, A.D.; Shultz, E.B. Jr. 1980.

From Tree crops for energy co-production on farms; Estes Park, CO, USA (12 Nov 1980).

There is a growing awareness that oil seed crops have considerable potential as a source of petroleum substitutes. They may be used directly as diesel fuel, are easily modified to substitute for other petroleum-based products, and are renewable. Seed fats undoubtedly will find increased utilization and markets as petroleum supplies dwindle. A high-yielding source of vegetable fat and oil for commercialization is being sought. The system under development utilizes the Chinese tallow tree, Sapium sebiferum (L). Roxb. (Euphorbiaceae), an introduced species that thrives in the lowlands of the the Gulf Coast and lower Eastern seaboard, areas that are currently of marginal agricultural value. This report summarizes our understanding of the characteristics, the problems, and the potential of the Chinese tallow tree system. The Chinese tallow tree is an introduced semi-tropical euphorb now naturalized in the coastal lowlands from South Carolina to Texas and, under cultivation, capable of annual yields of over 4000 lb/acre of vegetable tallow and oil. It grows in poorly-drained saline soils, is disease and insect resistant, and possesses considerable genetic variability. The tallow tree has a long history of culture, and its products are familiar to oil chemists; it is thus poised for development as a modern crop. The major technical barrier is the necessity for development of a system for mechanical harvest.

16660 **(SERI/PR—8143-1-T3) Development of copper sulfide/cadmium sulfide thin-film solar cells.** Szedon, J.R.; Biter, W.J.; Abel, J.A.; Dickey, H.C.; Shirland, F.A. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 27 Feb 1981. Contract AC02-77CH00178. 78p. NTIS, PC A05/MF A01.

The purpose of this work has been to identify aspects of cell fabrication and treatment which are critical for achieving high efficiency Cu_2S/CdS solar cells. In approaching the problem several comparisons were made of the effects of specific steps in two methods of cell fabrication. These methods had previously given cells of about 6% and a maximum of 9% efficiency. Three areas requiring special attention and specific means to achieve acceptable results were identified. (1) The Cu_2S/CdS heterojunction area must be minimized. If single source evaporations of CdS are made on substrates whose temperatures ($\sim$ 220°C) are monitored and controlled using welded thermocouples, the CdS films will have adequately large grains (grain diameter $\geqq$ 2 μm) and will not develop significant etch pits during texturing in a mild etchant solution. (2) The termination of the wet barrier processing steps must be done

carefully. An acceptable termination involves minimizing the amount of cuprous chloride retained on the cell surface during transfer to a rinsing stage while providing adequate exclusion of air from the space above the surface of the cuprous chloride solution. (3) Once formed, the Cu_2S layer should not be exposed to high temperatures (>100°C) for long periods of time (> 5 min) if surface adsorbed moisture or oxygen are present. Heat treatments in ampoules under flowing hydrogen atmospheres should be preceded and followed by periods of at least 30 minutes at room temperature in the reducing ambient. If all these precautions are taken, wet chemical barrier processing of thermally evaporated CdS films on zinc-plated copper foil substrates yields cells of nearly 8% conversion efficiency without AR coating.

16661 **(SERI/TR—631-1004) Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor.** Bohn, M.; Benham, C. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1981. Contract AC02-77CH00178. 22p. NTIS, PC A02/MF A01.

Pyrolysis experiments were performed using 30 and 90cm entrained-flow reactors, with steam as a carrier gas and two different feedstocks - wheat straw and powdered material drived from municipal solid waste (ECO-II TM). Reactor wall temperature was varied from 700° to 1400°C. Gas composition data from the ECO-II tests were comparable to previously reported data but ethylene yield appeared to vary with reactor wall temperature and residence time. The important conclusion from the wheat straw tests is that olefin yields are about one half that obtained from ECO-II. Evidence was found that high olefin yields from ECO-II are due to the presence of plastics in the feedstock. Batch experiments were run on wheat straw using a Pyroprobe/sup TM/. The samples were heated at a high rate (20,000° C/sec) to 1000° and held at 1000°C for a variable period of time from 0.05 to 4.95s. For times up to 0.15s volume fractions of ethylene, propylene, and methane increase while that of carbon dioxide decreases. Subsequently, only carbon monoxide and hydrogen are produced. The change may be related to poor thermal contact and suggests caution in using the Pyroprobe.

16662 **(SERI/TR—8272-1-T1) Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980.** Storti, G.; Regnault, W.; Johnson, S.; Lin, H.C.; Armstrong, R.W. (Solarex Corp., Rockville, MD (USA); Maryland Univ., Baltimore (USA)). 1980. Contract AC02-77CH00178. 197p. NTIS, PC A09/MF A01.

A considerable effort was directed to determine the mechanisms which limit efficiency in polysilicon solar cells. Specifically, the study was directed toward determining both the effects of impurities (for MG silicon material) and the microstructure of the polysilicon material on the electrical characteristics of solar cells fabricated from this material. Impurity effects were investigated using deep level transient spectroscopy (DLTS) to measure deep trap levels; optical emission spectroscopy and secondary ion mass spectroscopy (SIMS) were used to measure impurity levels. The effects of the crystal microstructure were investigated using electron channelling, angle lapping and staining measurements, x-ray topography, and scanning photoresponse measurements. Both reflection and transmission x-ray topographs of polysilicon material were obtained to reveal a range of microstructural features, including individual dislocations; subgrain boundaries, twin traces, and inclusions. The x-ray topographs were matched with optical scanning photoresponse measurements of the same region for which angle lapping results were obtained to show directly the effect of the microstructural features on the photoresponse of individual solar cells. A model is presented of these observations which gives emphasis to the individual effect of particular grain boundaries on reducing the photoresponse according to the dislocation content required to account for a portion of the misorientation across adjacent grains. The quality of the silicon grain volumes is the most important factor in determining the electrical response of polysilicon solar cells. Although the effect of impurities (for MG slicon material) on the quality of the grain volumes was not quantified, the incorporaton of impurities into the grain volumes is proposed to be, at least, indirectly related to the dislocation structure and that the electrical properties will be determined by the combination of the effects.

16663 **Electrolyte properties for photoelectrochemical cells with emphasis on the molecular adaptation of metallocenes: a review.** Gale, R.J.; Dubow, J. (Colorado State Univ., Fort Collins). *Solar Energy Materials ;* **4**: No. 2, 135-149(Jan 1981).

The intention of this review is to highlight the interplay of variables encountered in the selection and optimization of electrolytes for photoelectrochemical cells. Electrolyte properties have been exemplified for metallocene redox systems and, wherever possible, the flexibility and scope for further improvements in electrolyte design are indicated. 99 references.

16664 **Energy from biomass and wastes: 1980 update.** Klass, D.L. Chicago, IL; Institute of Gas Technology (1981). 58p. (CONF-810116—2).

From 5. annual IGT meeting on energy from biomass and wastes; Lake Buena Vista, FL, USA (26 Jan 1981).

The status of the technology on energy from biomass and wastes in the United States is reviewed. The Energy Security Act and other Federal laws enacted in 1980 have resulted in a major increase of funding to commercialize energy from biomass and wastes, particularly those processes that manufacture ethanol. Research and development on biomass production, gasification, and liquefaction have continued to cover all facets of the technology. However, changes in the direction of many of these programs are occurring to give near-term objectives higher priority. Despite the flurry of activity and the development of new concepts, integrated biomass-to-energy systems are still non-existent. Commercial technology currently includes fermentation ethanol plants; wood and municipal solid waste combustion plants for heat, steam, and electric power production; small-scale anaerobic digesters for farm wastes; air-blown wood gasification units for low-Btu gas manufacture; moderate-scale methane recovery systems in wastewater treatment plants and solid waste landfills; and one municipal solid waste gasification plant. Near-term commercial projects include a small-scale thermochemical waste gasification plant and a moderate-scale anaerobic digestion plant for manure. Several fermentation alcohol and waste combustion plants and landfill methane systems are either in the construction or advanced design stages. Overall, 1980 showed a modest increase in small- and moderate-scale commercial energy recovery systems fueled with biomass and wastes. The usage rate is definitely increasing.

16665 **Petroleum plantations for fuel and materials.** Calvin, M. (Univ. of California, Berkeley). *Bioscience ;* **29**: No. 9, 533-538(Sep 1979).

The need for alternative energy sources is discussed. Hydrocarbon-producing plants and sugar crops as possible energy sources are suggested. Several species of Euphorbia have been grown on plantations in the USA, Japan, Mexico, Morroco, and Ethiopia. The economics of developing hydrocarbon-producing biomass plantations and process machinery are discussed. (RJC)

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 16631, 16710, 16882

16666 (CONF-800483—(Vol.2), pp 839-846) **Solar energy for charging fork truck batteries.** Viljoen, T.A.; Turner, W.C. (Oklahoma State Univ., Stillwater). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The demand for renewable energy sources has stimulated technological advances in solar cell development. Initially, development and fabrication were extremely costly and no encouragement for use in industrial applications was made. Today, evidence exists that new technological advances and mass-production techniques have lowered the costs considerably. The US Department of Energy has indicated that by the year 1990 the price per peak watt would be less than fifty US cents. This price decrease is kept in mind and an economic study is done on the feasibility of using photovoltaic cells to charge electric fork lift trucks, at different costs per peak watt. This particular idea could be used as a measure of energy conservation for industrial material handling. Two evaluation methods were used; namely, the Payback Method, and the

Modified Energy Inflation Rate Method. Neither of the methods proved to be economically favorable, but some interesting results were obtained.

16667 **(CONF-800567—5) Residential solar-photovoltaic power systems: the need for battery storage.** Mueller, R.O.; Cha, B.K.; Giese, R.F.; Maslowski, C. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01.

From International symposia alternative energy sources and technology; Montreal, Canada (28 May 1980).

Benefits of battery storage used in conjunction with residential solar photovoltaic (PV) power systems were evaluated for a representative set of utility service areas. The PV systems were assumed capable of exporting excess power to the utility grid, and the batteries sited at the substation level were operated as a form of load-leveling utility storage. A cost-allocation model, SIMSTOR, was employed to determine utility fuel and capital cost savings resulting from the addition of batteries as a function of PV system penetration level. These benefits were compared with the savings of batteries used alone without introduction of the PV systems. Battery storage capacities and discharge rates were varied to determine the battery configurations that maximize net utility savings as a function of battery costs. Installed (rated) PV device capacities up to 20 percent of the generation peak load in each service area were considered. Findings indicate that batteries and PV systems are complementary rather than competing technologies, when attached to the electric supply grid. The utility benefits of the PV systems are primarily fuel savings, while those of the battery are primarily due to savings in utility capacity. The economic rationale for batteries does not change significantly as the penetration level for the PV systems increases. In some of the service areas, the addition of the PV systems tended to sharpen rather than flatten the peaks in the utility's load curves, with the magnitude of the effect becoming more pronounced at the higher PV system penetration levels. As a result of these load shape changes, batteries with higher discharge rates and larger storage capacities were favored.

16668 **(DOE/ET/20279—120) Heat pumps and utility-interactive photovoltaic power systems.** Sheldon, D.B. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1981. Contract AC02-76ET20279. 5p. (CONF-810509—8). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

Experimental data are presented which describe the performance of a residential air-source heat pump when it was driven by a utility-interactive photovoltaic power system. The heating capacity and coefficient of performance of the heat pump were determined at different outdoor coil supply air temperatures. This was done when the heat pump was powered exclusively by the utility and then repeated when a substantial fraction of the utility power was displaced by photovoltaic power. The data show that the heat pump's steady-state performance when driven by the utility-interactive photovoltaic power system is nearly indistinguishable from its conventional steady-state operation. Difficulties which may arise due to compressor start-up transients are discussed.

16669 **(DOE/ET/20279—122) Three-year performance study of the Mead, Nebraska, 25-kWp photovoltaic power system.** Bullwinkel, H.J.; Hopkinson, R.F. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1981. Contract AC02-76ET20279. 6p. (CONF-810509—7). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

During the past three years (1978 to 1980), a 25-kWp photovoltaic (PV) solar energy system has provided 107-MW hours of energy to the University of Nebraska's Agricultural Research Station in Mead, Nebraska. Electrical energy produced by the PV system has provided 100% of the power needed throughout the growing season to meet the irrigation requirements for an 80-acre cornfield, as well as significant portions of power required for PV-related crop-drying and fertilizer-manufacturing experiments. Annual array output averaged 21.4 kWh (1978), 20.4 kWh (1979) and 19.0 kWh (1980) for every 1.0 kWh/m^2 of insolation. Field data indicate that the PV system, developed and maintained jointly by the Massachusetts Institute of Technology (MIT) Lincoln Laboratory and the University of Nebraska under US Department of Energy (DOE) sponsorship, has performed up to expectations, if due allowance is made for component degradation and seasonal soil/snow accumulation on the array.

16670 **(DOE/ET/20279—126) Reliability of terrestrial photovoltaic modules at various DOE/MIT Lincoln Laboratory Test Sites.** Forman, S.E.; Themelis, M.P. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Mar 1981. Contract AC02-76ET20279. 5p. (CONF-810526—1). NTIS, PC A02/MF A01.

From 15. IEEE PV specialists conference; Orlando, FL, USA (11 May 1981).

During the past four years, acting under the auspices of the US Department of Energy, Massachusetts Institute of Technology Lincoln Laboratory has built and operated in the United States photovoltaic power-generating systems ranging in size from less than 1 kWp to 100 kWp. Slightly more than 11,000 modules from several manufactures have been utilized at these sites with a cumulative number of electrical failures of approximately 2%. Discussion is presented of module performance at two of these sites; a 25-kWp array field at Mead, Nebraska, and a 100-kWp array field at Natural Bridges National Monument, Utah. Data and photographs of module failures, failure modes, physical and electrical degradation, and array diagnostics are presented for each of the five different types of modules utilized at these sites.

16671 **(DOE/ET/20279—129) Solar photovoltaic residence in Carlisle, Massachusetts.** Strong, S.J.; Nichols, B.E. (Solar Design Associates, Lincoln, MA (USA); Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1981. Contract AC02-76ET20279. 4p. (CONF-810509—9). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

The first solar photovoltaic house designed and constructed under the US Department of Energy's Solar Photovoltaic Residential Project has been completed. The house, which is powered by a 7-kWp PV system, will be used to assess the occupants' acceptance of and reactions to residential photovoltaic systems and to familiarize utilities, builders, developers, town building officials and others with issues concerning photovoltaic installations. The house is located on a two-acre lot in Carlisle, approximately twenty miles northwest of Boston. Built by a local architect/developer team, the house includes energy conservation and passive solar features. It utilizes a roof-mounted, flat-plate PV array which operates in a two-way energy exchange mode with the electric utility. The energy conservation and passive solar features of this house are described and a detailed description of the utility-interactive photovoltaic system is presented, along with initial performance data.

16672 **(DOE/ET/25202—1(Vol.1)) Analysis of batteries for use in photovoltaic systems. Final report.** Podder, A.; Kapner, M. (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1981. Contract AC01-79ET25202. 194p. NTIS, PC A09/MF A01.

An evaluation of 11 types of secondary batteries for energy storage in photovoltaic electric power systems is given. The evaluation was based on six specific application scenarios which were selected to represent the diverse requirements of various photovoltaic systems. Electrical load characteristics and solar insulation data were first obtained for each application scenario. A computer-based simulation program, SOLSIM, was then developed to determine optimal sizes for battery, solar array, and power conditioning systems. Projected service lives and battery costs were used to estimate life-cycle costs for each candidate battery type. The evaluation considered battery life-cycle cost, safety and health effects associated with battery operation, and reliability/maintainability. The 11 battery types were: lead-acid, nickel-zinc, nickel-iron, nickel-hydrogen, lithium-iron sulfide, calcium-iron sulfide, sodium-sulfur, zinc-chlorine, zinc-bromine, Redox, and zinc-ferricyanide. The six application scenarios were: (1) a single-family house in Denver, Colorado (photovoltaic system connected to the utility line); (2) a remote village in equatorial Africa (stand-alone power system); (3) a dairy farm in Howard County, Maryland (onsite generator for backup power); (4) a 50,000 square foot office building in Washing-

ton, DC (onsite generator backup); (5) a community in central Arizona with a population of 10,000 (battery to be used for dedicated energy storage for a utility grid-connected photovoltaic power plant); and (6) a military field telephone office with a constant 300 W load (trailer-mounted auxiliary generator backup). Recommendations for a research and development program on battery energy storage for photovoltaic applications are given, and a discussion of electrical interfacing problems for utility line-connected photovoltaic power systems is included. (WHK)

16673 **(DOE/ET/25202—1(Vol.2)) Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report.** Podder, A.; Kapner, M.; Morse, T. (Hittman Associates, Inc., Columbia, MD (USA)). Feb 1981. Contract AC01-79ET25202. 278p. NTIS, PC A13/MF A01.

The objective of this study was to compile an up-to-date comprehensive data base for research, design, and development of photovoltaic systems, primarily in the areas of applications and battery technology, and secondarily in the area of power conditioning and photovoltaic array technology. This volume contains the data base used to develop the end-use scenarios and identify the R and D needed for batteries to be used in photovoltaic power systems. In addition to its specific application to the present study, this data base is intended to provide state-of-the-art information to manufacturers of the various components of photovoltaic power systems, system designers, and researchers in this field. An extensive literature search was conducted to obtain technical data on batteries, power conditioners, and photovoltaic arrays. The data obtained from published technical literature and direct communication with manufacturers and developers are compiled. Principles of operation, types of systems, performance characteristics, test data, and cost data are included for each of the components. (WHK)

16674 **(DOE/JPL/955298—T1) Interim standard for safety: flat-plate photovoltaic modules and panels. Volume 1. Construction requirements.** (Jet Propulsion Lab., Pasadena, CA (USA)). 20 Feb 1981. Contract NAS-7-100-955298. 25p. NTIS, PC A02/MF A01.

Underwriters Laboratories, Inc., under contract to the Jet Propulsion Laboratory (JPL), has conducted a study of present photovoltaic module array designs and configurations likely to be used in residential, commercial, and industrial applications. That investigation of engineering safety requirements has resulted in the development of this Interim Standard for Safety. This document, primarily written by Underwriters Laboratories, Inc. (UL), is published in two volumes. Volume I, Construction Requirements, contains safety requirements for flat-plate photovoltaic modules and panels. Volume II, Performance Requirements, contains test procedures and methods to verify compliance with the safety requirements set forth in Volume I. The purpose of these documents is to offer to the flat-plate photovoltaic's community, for trial use, this Interim Standard for Safety as part of JPL's Low-Cost Solar Array (LSA) Project. This volume is intended to be used on a trial basis with the latest Block V Module Procuremenet Specifications for Intermediate Load and Residential Applications, 5101-161 and 5101-162, respectively. This use will support such things as future module procurements and module development activities sponsored by the US Department of Energy.

16675 **(SERI/SP—433-487) Photovoltaics: solar electric power systems.** (Solar Energy Research Inst., Golden, CO (USA)). Feb 1980. Contract AC02-77CH00178. 21p. NTIS, PC A02/MF A01.

The operation and uses of solar cells and the National Photovoltaic Program are briefly described. Eleven DOE photovoltaic application projects are described including forest lookout towers; Wilcox Memorial Hospital in Hawaii; WBNO daytime AM radio station; Schuchuli Indian Village; Meade, Nebraska, agricultural experiment; Mt. Laguna Air Force Station; public schools and colleges; residential applications; and Sea World of Florida. (WHK)

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 16627, 16630, 16633, 16634, 16635, 16636, 16717, 17541

16676 (CONF-800483—(Vol.2), pp 820-830) **Look to the future: solar repowering for tomorrow's energy needs.** Wendt, M. (Texas Electric Service Co., Fort Worth). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

One provision of the National Energy Act of 1978 is to restrict the use of oil and natural gas in industrial boilers. In order to research methods of providing alternate fuel sources for the boilers, the Department of Energy initiated a program to investigate the technical feasibility and cost-effectiveness of central solar-thermal energy technology. Projected development of this program includes studies of utility and industrial sites for application and the possibility of constructing one or more demonstration sites. Current solar-central-receiver technology is discussed, specifically outlining a feasibility study of the solar-repowering concept by Texas Electric Service Company and Rockwell International.

16677 **(MCR—78-1325) Collector subsystem for the 10 MW/sub e/ solar thermal central receiver pilot plant. Phase 1. Technical status report, Issue 5.** (Martin Marietta Corp., Denver, CO (USA)). Feb 1979. Contract AC03-79ET21007. 20p. NTIS, PC A02/MF A01.

The objective of this program is to develop a production design and fabricate preproduction hardware for the collector subsystem for the 10 MW solar thermal central receiver pilot plant. Progress is reported in the following areas: control subsystem, mechanical/structural design, mirror assembly, test operations, manufacturing and tooling, and logistics. (WHK)

16678 **(MCR—79-1311) Overall plant design description for collector subsystem for the 10-MW/sub e/ solar-thermal central-receiver pilot plant. Phase 1.** (Martin Marietta Corp., Denver, CO (USA)). Apr 1979. Contract AC03-79ET21007. 20p. NTIS, PC A02/MF A01.

The design of the heliostat array, drive mechanism, pedestal, control systems, and cabling for the planned Barstow 10-MW central receiver pilot plant is described. (WHK)

16679 **(SAND—80-2378) 1980 annual report of the Coolidge Solar Irrigation Project.** Torkelson, L.; Larson, D.L. (Sandia National Labs., Albuquerque, NM (USA); Arizona Univ., Tucson (USA). Dept. of Soils, Water and Engineering). Feb 1981. Contract AC04-76DP00789. 160p. NTIS, PC A08/MF A01.

The Coolidge Solar Irrigation Facility at Coolidge, Arizona, consists of a 2136.8-m^2 (23,000-ft^2) line-focus parabolic trough collector subsystem, a 113.55-m^3 (30,000-gallon) thermal storage subsystem, and a 150-kW/sub e/ (142.2-Btu/s) organic Rankine cycle power generation unit. The performance of the facility and its operational and maintenance requirements are reported. The period from the the facility's initial operation in October 1979 to 31 August 1980 is covered.

16680 **(SAND—80-8052) Molten nitrate salt technology development status report.** Carling, R.W.; Kramer, C.M.; Bradshaw, R.W.; Nissen, D.A.; Goods, S.H.; Mar, R.W.; Munford, J.W.; Karnowsky, M.M.; Biefeld, R.N.; Norem, N.J. (Sandia National Labs., Livermore, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP0079. 115p. NTIS, PC A06/MF A01.

Recognizing thermal energy storage as potentially critical to the successful commercialization of solar thermal power systems, the Department of Energy (DOE) has established a comprehensive and aggressive thermal energy storage technology development program. Of the fluids proposed for heat transfer and energy storage molten nitrate salts offer significant economic advantages. The nitrate salt of most interest is a binary mixture of $NaNO_3$ and KNO_3. Although nitrate/nitrite mixtures have been used for decades as heat transfer and heat treatment fluids the use has been at temperatures of about 450°C and lower. In solar thermal power systems the salts will experience a temperature range of 350 to

600°C. Because central receiver applications place more rigorous demands and higher temperatures on nitrate salts a comprehensive experimental program has been developed to examine what effects, if any, the new demands and temperatures have on the salts. The experiments include corrosion testing, environmental cracking of containment materials, and determinations of physical properties and decomposition mechanisms. This report details the work done at Sandia National Laboratories in each area listed. In addition, summaries of the experimental programs at Oak Ridge National Laboratory, the University of New York, EIC Laboratories, Inc., and the Norwegian Institute of Technology on molten nitrate salts are given. Also discussed is how the experimental programs will influence the near-term central receiver programs such as utility repowering/industrial retrofit and cogeneration. The report is designed to provide easy access to the latest information and data on molten $NaNO_3/KNO_3$ for the designers and engineers of future central receiver projects.

16681 **(SERI/TP—633-1148) Applied research in the solar thermal-energy-systems program.** Brown, C.T.; Lefferdo, J.M. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 7p. (CONF-810509—10). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

Within the Solar Thermal Research and Advanced Development (RAD) program a coordinated effort in materials research, fuels and chemical research and applied research is being carried out to meet the systems' needs. Each of these three program elements are described with particular attention given to the applied research activity.

16682 **(UCID—18977) Electricity generation by solar central receivers.** Dorn, D.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Mar 1981. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

Various approaches for generating electricity are being explored that can lead to a cost-effective solar central-receiver plant. Experimental data have been accumulated, and pilot plants are now being built. The projected capital cost (1979 dollars) of a commercial solar central-receiver plant with a 50% capacity factor is about $1400/kW/sub e/. The cost of electricity from such a plant is expected to be about 7.5 cents/kWh.

16683 **(SAND—79-8194(Vol.2)(App.)) Second generation heliostat development for solar central receiver systems detailed design report. Volume II. Appendices.** (Northrup, Inc., Hutchins, TX (USA); Bechtel National, Inc., San Francisco, CA (USA); Booz, Allen and Hamilton, Inc., Cleveland, OH (USA)). May 1980. 315p. NTIS, PC A14/MF A01.

Presented are the design of the second generation heliostat, the development of the manufacturing plan, the method of transporting the heliostats from the factory to the installation site, heliostat installation procedures, and the maintenance routines. These plans are then cost estimated to provide inputs required to develop the installed cost of the heliostat and further, the cost of owning, operating and maintaining a collector field. This volume contains the following appendices: (1) bill of materials; (2) part drawings (subassemblies); (3) assembly drawings, heliostat; (4) trade studies; (5) system studies; (6) control software; (7) test results; (8) specification S-102: surface preparation, application, and inspection of protective coatings for carbon steel heliostat piles; and (9) specification S-101: installation of open end pipe piles. (WHK)

1408 Ocean Thermal Gradient And Salinity Gradient Power Systems

16684 **(JHU/APL-SR—80-1A) Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume A. Detailed report.** George, J.F.; Richards, D. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Jun 1980. Contract AI01-77ET20342. 270p. NTIS, PC A12/MF A01.

The Applied Physics Laboratory (APL) of the Johns Hopkins University has engineered baseline designs of two types of floating Ocean Thermal Energy Conversion (OTEC) pilot plants. Both designs feature floating concrete hull structures that house up to 40 MW/sub e/(net) of OTEC power systems. One plant is designed for moored operation at an island site, and uses underwater cables to transmit electric power to a shore-based utility company. The other plant is self-propelled and cruises slowly through tropical waters, using the OTEC electric power to produce an energy-intensive product onboard, where it is stored for later transshipment to market. The work is documented in two volumes. This volume is the Detailed Report, which develops the design rationale, summarizes important calculations, outlines areas for future work, and presents a study of system costs.

16685 **(JHU/APL-SR—80-1B) Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume B. Engineering drawings.** (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Jun 1980. Contract AI01-77ET20342. 123p. NTIS, PC A06/MF A01.

This is one part of a two-volume report that presents baseline design data for two types of floating Ocean Thermal Energy Conversion (OTEC) pilot plants: (a) a moored plant that uses underwater cables to transmit electric power to a shore-based utility company, and (b) a cruising plantship that uses the OTEC electric power to produce an energy-intensive product onboard, where it is stored for later transshipment to market. This volume provides the engineering drawings of the hull, cold-water pipe, ship outfitting and machinery, OTEC power system, electrical system, and folded-tube heat exchangers.

16686 **(LBL—12328) Draft environmental assessment: Ocean Thermal Energy Conversion (OTEC) Pilot Plants.** Sullivan, S.M.; Sands, M.D.; Donat, J.R.; Jepsen, P.; Smookler, M.; Villa, J.F. (Interstate Electronics Corp., Anaheim, CA (USA)). Feb 1981. Contract W-7405-ENG-48. 222p. NTIS, PC A10/MF A01.

This Environmental Assessment (EA) has been prepared, in accordance with the National Environmental Policy Act of 1969, for the deployment and operation of a commercial 40-Megawatt (MW) Ocean Thermal Energy Conversion (OTEC) Pilot Plant (hereafter called the Pilot Plant). A description of the proposed action is presented, and a generic environment typical of the candidate Pilot Plant siting regions is described. An assessment of the potential environmental impacts associated with the proposed action is given, and the risk of credible accidents and mitigating measures to reduce these risks are considered. The Federal and State plans and policies the proposed action will encompass are described. Alternatives to the proposed action are presented. Appendix A presents the navigation and environmental information contained in the US Coast Pilot for each of the candidate sites; Appendix B provides a brief description of the methods and calculations used in the EA. It is concluded that environmental disturbances associated with Pilot Plant activities could potentially cause significant environmental impacts; however, the magnitude of these potential impacts cannot presently be assessed, due to insufficient engineering and environmental information. A site- and design-specific OTEC Pilot Plant Environmental Impact Statement (EIS) is required to resolve the potentially significant environmental effects associated with Pilot Plant deployment and operation. (WHK)

16687 **(SERI/TR—751-752) Ocean energy researchers information user study.** Belew, W.W.; Wood, B.L.; Marle, T.L.; Reinhardt, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 124p. NTIS, PC A06/MF A01.

This report describes the results of a series of telephone interviews with groups of users of information on ocean energy systems. These results, part of a larger study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. The report is 1 of 10 discussing study results. The overall study provides baseline data about information needs in the solar community. Only high-priority groups were examined. Results from 2 groups of researchers are analyzed in this report: DOE-Funded Researchers and Non-DOE-Funded Researchers. The data will be used as input to the determination of information products and services the Solar Energy Research Institute, the Solar Energy Information Data Bank Network,

and the entire information outreach community should be preparing and disseminating.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 16378, 16627, 16629, 16629, 16630, 16633, 16961, 17036

16688 (ANL/EES-TM—128) Results of an accuracy test of the Mod-II Site Data Acquisition System. Patterson, D.R. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 43p. NTIS, PC A03/MF A01.

The National Solar Data Network collects and analyzes data on the performance of active and passive solar-energy systems throughout the United States. The accuracy of the specially designed Site Data Acquisition System (SDAS) used in the network has not been adequately characterized. Uncertainty about the SDAS's accuracy has become one of the major limitations in evaluating the accuracy of the network. The results of SDAS testing for basic calibration accuracy and for errors caused by changes in ambient temperature, changes in a-c line voltage, drift with time, changes in loading on the excitation power supplies, channel-to-channel cross-talk, and maintenance. System accuracy was found to depend on the configuration of the SDAS channel. Over one year of operation and with the expected changes in temperature and ac line voltage, an accuracy of 0.6% of the input signal plus one count, with error-free initial calibrations assumed, was typical. For a full-scale signal, this error is seven counts. Most of the error is introduced through the power supplies used for sensor excitation; with improved power supplies, this seven-count error could be reduced to two counts. Most of the accuracy testing was conducted on only one ADAS, a Mod-II unit. Therefore, generalizations to other SDAS units are difficult. However, a Mod-II SDAS probably will not have errors less than half or more than twice as great as those measured and reported here.

16689 (ANL-K—80-44) Economic analysis of non-taxed commercial solar hot water systems and combined heating and hot water systems. (Mueller Associates, Inc., Baltimore, MD (USA)). 23 Sep 1980. Contract W-31-109-ENG-38. 85p. NTIS, PC A05/MF A01.

Typical commercial solar energy systems is described, outlining typical cost and performance levels. The economic performance of solar energy systems are described through the use of Cash Flow Diagrams. These diagrams indicate the cumulative cash situation of a solar investment over the life of the investment. The economic performance of solar energy systems is described through the calculation of equivalent Return-on-Investment (ROI). Appendices are included that enable one to calculate the ROI for any particular solar energy system investment. (MHR)

16690 (ANL-K—80-53) Economic analysis of commercial solar combined space-heating and hot-water systems. (Mueller Associates, Inc., Baltimore, MD (USA)). 23 Sep 1980. Contract W-31-109-ENG-38. 66p. (MAI—204). NTIS, PC A04/MF A01.

Typical commercial solar energy systems are described, outlining typical cost and performance lvels. The economic performance of solar energy systems are described through the use of Cash Flow Diagrams. These diagrams indicate the cumulative cash situation of a solar investment over the life of the investment. The economic performance of solar energy systems is described through the calculation of equivalent Return-on-Investment (ROI). Appendices are included that enable one to calculate the ROI for any particular solar energy system investment. (MHR)

16691 (ANL-K—80-59) Economic analysis of residential and commercial solar heating and hot water systems. (Mueller Associates, Inc., Baltimore, MD (USA)). 23 Sep 1980. Contract W-31-109-ENG-38. 21p. (MAI—206). NTIS, PC A02/MF A01.

The economic evaluation of residential and commercial solar heating and hot water systems is presented. Commercial systems are further categorized as taxable and non-taxable applications in recognition of the effect of Federal and state tax incentives and disincentives for solar energy systems. The economic evaluation of each system type is performed utilizing two distinct methods of analysis. The economic analyses follow a brief description of each method. The Cash Flow Analyses provide insight into the short and long term effects of a solar investment on the budget of the solar energy system purchaser while the Return-On-Investment Analyses provide an appropriate method of measuring the attractiveness of a solar investment in comparison to alternative long term investments. Utilizing a typical system for each system type and application the Cash Flow and Return-On-Investment Analyses are presented. The sensitivity of the results on the numerous variables in the economic analyses is shown. Maps provide a graphic display of the results of the economic analysis of typical systems using Federal and state tax credits and average state conventional fuel costs for each system type. Conclusions based on the economic analyses performed and a thorough discussion of the present status of the data required for the complete economic evaluation of solar energy systems are summarized. The current availability and limitations of data and requirements for further work in this area are discussed.

16692 (ANL-K—80-68) Economic analysis of residential solar water heaters. (Mueller Associates, Inc., Baltimore, MD (USA)). 23 Sep 1980. Contract W-31-109-ENG-38. 98p. (MAI—201). NTIS, PC A05/MF A01.

A typical residential solar water heater, and typical cost and performance information are described briefly. The monthly costs and savings of the typical system are discussed. Economic evaluations of solar water heaters are presented in increasingly complex levels of detail. Utilizing a typical system, the effective interest rate that the purchaser of a system would receive on money invested is shown for all regions of the country. The importance of numerous variables that can make a significant difference on the economics of the system is described. Methods for calculating the Payback Period for any non-typical solar water heater are described. This calculated Payback Period is then shown to be related to the effective interest rate that the puchaser of the system would receive for a typical set of economic conditions. A method is presented to calculate the effective interest rate that the solar system would provide. (MHR)

16693 (DOE/CS/30062—1) Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Sep 1980. Contract AC02-79CS30062. 584p. NTIS, PC A25/MF A01.

This manual was prepared as a text for a training course on solar heating and cooling of residential buildings. The course and text are directed toward sizing, installation, operation, and maintenance of solar systems for space heating and hot water supply, and solar cooling is treated only briefly. (MHR)

16694 (DOE/CS/31713—T1) Solar production of industrial process steam. Phase III. Operation and evaluation of the Johnson and Johnson solar facility. Final report, January 1, 1980-March 31, 1981. Brink, D.F.; Kendall, J.M.; Youngblood, S.B. (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). Mar 1981. Contract AC03-77CS31713. 110p. NTIS, PC A06/MF A01.

A solar facility that generates 177°C (350°F) process steam has been designed and constructed by Acurex Corporation and has operated for 1 yr supplying steam to the Johnson and Johnson manufacturing plant in Sherman, Texas. The facility consists of 1068 m^2 (11,520 ft^2) of parabolic trough concentrating collectors, a 18,900 l (5000 gal) flash boiler, and an 18.6 kW (25 hp) circulating pump. In the first year of operation the system was available 97 percent of the days, and with sufficient solar radiation available it operated 70 percent of the days during this period. The measured data showed that the collector field operated at an efficiency of 25.4 percent for the year, and that at least 75 percent of the energy reaching the flash boiler was delivered to the plant as steam. A total of 309,510 kg (682,400 lb) of steam was produced by the solar facility for the first year. An analysis of the data showed that the delivered energy was within 90 to 100 percent of the predicted value. The successful completion of the first year of operation has demonstrated the technical feasibility of generating industrial process steam with solar energy.

16695 **(DOE/CS/32223—T1) High-temperature process-steam application at the Southern Union Refining Company, Hobbs, New Mexico (solar energy in the oil patch). Phase I design. Final report.** (Energetics Corp., Richardson, TX (USA)). 31 Jul 1979. Contract AC03-78CS32223. 314p. NTIS, PC A14/MF A01.

Southern Union Refining Company's Famariss Energy Refinery has worked diligently with Monument Solar Corporation in the conceptual and detail design for this unique application of solar generated steam. An area closely adjacent to the refinery and fronting New Mexico State Highway No. 18 has been designated for the solar collector array. Space planned for the demonstration parabolic trough array is sufficiently large to handle an array of 25,200 square feet in size - an array more than twice the size of the 10,080 square feet proposed originally. The conceptual design, performance, safety, environmental impact, and economic analysis are described. Engineering drawings are included. (WHK)

16696 **(DOE/CS/34510—T1) Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump.** (United Technologies Research Center, East Hartford, CT (USA); United Technologies Corp., Windsor Locks, CT (USA). Hamilton Standard Div.). Mar 1981. Contract AC03-77CS34510. 324p. (UTRC-R—79-953050-1). NTIS, PC A14/MF A01.

A program described to design, fabricate, and conduct preliminary testing of a prototype solar-powered Rankine cycle turbocompressor heat pump module for a multi-family residential building is presented. A solar system designed to use the turbocompressor heat pump module including all of the subsystems required and the various system operating modes is described in Section I. Section II includes the preliminary design analyses conducted to select the heat pump module components and operating features, working fluid, configuration, size and performance goals, and estimated performance levels in the cooling and heating modes. Section III provides a detailed description of the other subsystems and components required for a complete solar installation. Using realistic performance and cost characteristics for all subsystems, the seasonal performance of the UTC heat pump is described in various US locations. In addition, the estimated energy savings and an assessment of the economic viability of the solar system is presented in Section III. The detailed design of the heat pump module and the arrangement of components and controls selected to conduct the laboratory performance tests are described in Section IV. Section V provides a description of the special laboratory test facility, including the subsystems to simulate the collectors and storage tanks for building load and ambient conditions and the instrumentation, monitoring, and data acquisition equipment. The test results and sample computer analyses and comparisons with predicted performance levels are presented in Section VI. Various appendices provide supplementary and background information concerning working fluid selection (A), configuration selection (B), capacity control concepts (C), building models (D), computer programs used to determine component and system performance and total system economics (E), and weather data (F).

16697 **(DOE/R5/10213—1) Solar lease grant program. Technical progress report.** (Resource Alternatives, Mossville, IL (USA)). 1 Apr 1981. Contract FG02-80R510213. 10p. NTIS, PC A02/MF A01.

Progress on a lease program for the installation of a solar water heater with no installation charge is reported. Information on the announcement of the program, the selection of participants, the contractural agreement, progress on installation of equipment, monitoring, and evaluation is summarized. The status of the budget concerned with the program is announced. Forms used for applications for the program and an announcement from Resource Alternatives for Cilco customers are presented.

16698 **(DOE/R5/10215—1) Optimum utilization of site energy sources for all-season thermal comfort in new residential construction for single-family attached (rowhouse/townhouse) designs.** (Gerber (Sherman), Northbrook, IL (USA)). 26 Feb 1981. Contract FG02-80R510215. 16p. NTIS, PC A02/MF A01.

A proposed design analysis is presented of a passive solar energy efficient system for a typical three-level, three bedroom, two story, garage-under townhouse. The design incorporates the best, most performance-proven and cost effective products, materials, processes, technologies, and sub-systems which are available today. Seven distinct categories recognized for analysis are identified as: the exterior environment; the interior environment; conservation of energy; natural energy utilization; auxiliary energy utilization; control and distribution systems; and occupant adaptation. Preliminary design features, fenestration sysems, the plenum-supply system, the thermal-storage party-fire walls, direct gain storage, the radiant comfort system, and direct passive cooling systems are briefly described. Features of the design under analysis and on which conclusions have not yet been formulated are: the energy reclamation system, auxiliary energy back-up systems, the distribution system and operating modes, the control systems, and non-comfort energy systems and inputs. (MCW)

16699 **(DOE/R5/10246—1) Solar kiln demonstraction project. Semi-annual progress report.** (Sherwood Forest Products, Inc., Waverly, OH (USA)). 1980. Contract FG02-80R510246. 67p. NTIS, PC A04/MF A01.

Drawings for the solar lumber predrier demonstration project for Sherwood Forest products Corp. in Waverly, Ohio, are presented. Drawings are included for the site plan, foundation plan, floor plan, framing plan, and structural plan. Project status is outlined: site development work was initiated during the late fall of 1980 and some materials for the project have been acquired. (WHK)

16700 **(DOE/SF/01973—T1) Hardware package and workshop development for homeowner solar water heater.** Mumma, S.A. (Arizona State Univ., Tempe (USA). Coll. of Architecture). Sep 1980. Contract FG03-78SF01973. 288p. NTIS, PC A13/MF A01.

The project objective was the development of a hardware package and a companion two day workshop necessary to assist homeowners with the fabrication and installation of a solar water heater at a cost of $300 to $400. It was the purpose of this project to (1) develop a standard solar hot water heater package, (2) develop a workshop for the assembly of these components by the homeowner, (3) provide guidance on how the components may be retrofit to existing homes in accordance with local codes and good practices, (4) provide operating and maintenance instructions, and (5) provide this community serivce at a target cost of $300 to $400 for the complete solar water package including the enrollment and 1-1/2 day workshop. The solar hot water system's thermal performance and development of a solar company are discussed. Nationwide expansion of the program is proposed. Included in an appendix is a more thorough discussion of solar water heating system and workshop. Also included is a study of the potential of the workshop and how the potential can be reached. The workshop is evaluated statistically. A new double walled heat exchanger is also discussed. (LEW)

16701 **(MDC-G—8656ES) Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor Uranium Mill solar retrofit. Final technical report.** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA); Gulf Research and Development Co., Pittsburgh, PA (USA); Foster Wheeler Development Corp., Livingston, NJ (USA); Houston Univ., TX (USA)). Jun 1980. Contract AC03-79SF10608. 27p. NTIS, PC A03/MF A01.

This report covers the efforts in a nine month study to develop a site-specific conceptual design for solar industrial process heat retrofit of the Gulf Mt. Taylor Uranium Mill. This has resulted in preparation of a System Requirements Specification, conduct of trade studies leading to selection of a system concept, and conceptual design, performance, cost estimating and economic analysis of the selected concept. A baseline system with no storage and an alternative system with extended storage were evaluated. The baseline system with no storage was selected because it provides the best overall opportunity for fuel displacement, operating experience in industrial application and successful demonstration in the near term for both DOE and the user.

16702 **(PB—80-222516) Illinois solar greenhouse compendium.** Elrod, A.; Wheeler, A. (Illinois Inst. of Natural Resources, Springfield (USA)). Jun 1980. 36p. NTIS, PC A03/MF A01.

One of the most rapidly growing areas in solar energy is solar greenhouses. The functional versatility of these systems and low-costs make them attractive to large numbers of people in Illinois. The Compendium attempts to provide information on a variety of working systems around the state. Technical and economic information has been provided as well as site locations and contact persons. The publication is meant to offer examples and resource information for individuals interested in constructing similar projects.

16703 **(SERI/TP—631-1159) Use of an open-cycle absorption system for heating and cooling.** Schlepp, D.R.; Collier, R.K. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 7p. (CONF-810509—11). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

Solar cooling for commercial applications using open-cycle absorption refrigeration systems has been investigated and found to be feasible. If an open-cycle absorption system can be operated as a chemical heat pump for winter heating operation, the system would offer year-round operation that could make the system economically viable for many regions of the US. An analysis of heating operation for the open-cycle system is presented using a computer program that simulates heat and mass transfer processes for any environmental condition. The open-cycle absorption refrigeration system can be operated as a chemical heat pump. Simulations for winter heating operation were run for five US cities, with solar COP's in the range of .06 to .16. At these levels, the OCAR system can provide full heating and cooling operation for office buildings in many southern US cities.

16704 **(SERI/TP—632-1123) Status of current IPH applications.** Kearney, D.W. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 7p. (CONF-801208—3). NTIS, PC A02/MF A01.

From Annual IPH conference; Houston, TX, USA (16 Dec 1980).

The US Department of Energy has funded a series of field tests since 1977 to gain operational experience in the application of solar energy to industrial process heat requirements. To date, 34 design studies or actual installations have been funded utilizing technologies ranging from flat plates to line-focus concentrators to central receiver industrial systems. The types of solar systems include hot air, hot water, and steam production applied to a broad spectrum of industrial processes. The program elements are identified and put in perspective relative to transport fluid, temperature level, and size of the solar field. The status of these programs ranges from design studies to operational systems. Solar enhanced oil recovery and repowering have been studied. The chronological history of each program is tabulated. (LEW)

16705 **(SERI/TR—721-822) Comparison of DOE-2 and TRNSYS solar-heating-system simulation.** Eden, A.; Morgan, M. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 73p. NTIS, PC A04/MF A01.

The analysis and comparison of the output of the solar energy section of DOE-2 called Component Based Simulator (CBS) and TRNSYS are discussed. The adequacy and sensitivity of CBS when various active solar energy collectors and systems were interfaced with a standard space heating system were investigated. The analysis included both single- and double-glazed collectors with selectively and nonselectively coated absorbing surfaces located in four different environments. The results of the study show the agreement between the two programs to be remarkably similar. Graphs are presented to illustrate the minor differences in annual average collector efficiency and annual average part solar as well as the thermal load and insolation levels. In addition, difficulties encountered by the researchers when performing this study and when attempting to model the collector systems with each program's components are discussed and recommendations offered to facilitate the solar simulation process for future CBS users.

16706 **(SERI/TR—731-905) Value of thermal storage in solar IPH systems.** Hock, S.M.; Karpuk, M.E. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1980. Contract AC02-77CH00178. 7p. (CONF-810405—14). NTIS, PC A02/MF A01.

From 3. annual systems simulation, economic analysis/solar heating and cooling operational results conference; Reno, NV, USA (27 Apr 1981).

The value of thermal storage for three solar industrial process heat systems has been determined for storage capacities of 3 to 4000 hours. The dominant source of storage value is backup fuel savings with additional value derived from increased capital equipment utilization and elimination. A computer simulation was used to model the operation of the solar IPH system and predict the amount of fuel saved by heat delivered from storage. Sensitivity of storage value to process temperature, collector cost, load profile, insolation, and storage efficiency have been calculated. Storage values ranged from near zero to as high as $42/kWh of storage capacity.

16707 **(SERI/TR—751-751) Industrial and agricultural process heat information user study.** Belew, W.W.; Wood, B.L.; Marle, T.L.; Reinhardt, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 246p. NTIS, PC A11/MF A01.

The results of a series of telephone interviews with groups of users of information on solar industrial and agricultural process heat (IAPH) are described. These results, part of a larger study on many different solar technologies, identify types of information each group needed and the best ways to get information to each group. In the current study only high-priority groups were examined. Results from 10 IAPH groups of respondents are analyzed in this report: IPH Researchers; APH Researchers; Representatives of Manufacturers of Concentrating and Nonconcentrating Collectors; Plant, Industrial, and Agricultural Engineers; Educators; Representatives of State Agricultural Offices; and County Extension Agents.

16708 **(SOLAR/1008—80/50) Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico.** Moore, D. (Boeing Co., Seattle, WA (USA)). 2 Mar 1981. Contract AB01-76CS31020. 59p. NTIS, PC A04/MF A01.

The Homes By Marilynn solar energy system is installed in a multi family residence (duplex) located in Albuquerque, New Mexico. The system is designed to provide solar energy for space heating and preheating DHW. Solar energy is collected by 18 liquid flat plate collectors with a gross area of 346 square feet. Solar energy is transferred from the collector array to a 1000 gallon storage tank. Freeze protection is provided by a 50% ethylene glycol and 50% water. Solar energy is delivered to a liquid-to-air heat exchanger in the space heating subsystem in order to preheat outside air for the heat pump. Preheated city water is stored in a 30-gallon preheat storage tank and supplied, on demand, to a conventional 40-gallon DHW tank.

16709 **(DOE/R5/10235—1) Investigation of the potential application of solar energy to existing homes. Semi-annual technical progress report.** (Hokanson (Brad), Minneapolis, MN (USA)). [nd]. Contract FG02-80R510235. 11p. NTIS, PC A02/MF A01.

Progress is reported in designing passive solar retrofits for three older house types in Minneapolis. (MHR)

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 16679, 16683

16710 **(DOE/EIA—0174(80/2)) Energy data report. Solar collector manufacturing activity, July through December 1980.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Mar 1981. 50p. NTIS, PC A03/MF A01.

Statistics on solar collector manufacturing activity for both solar thermal collectors and photovoltaic modules through 1980 are

presented. Summary data are given for the number of manufacturers and collector area produced each year from 1974 through 1980; data for collector type are included, i.e. low temperature or medium temperature and special collectors. Producer shipments are tabulated according to location of company headquarters, producer size, and collector types. Import and export activity is tabulated; and tables are given showing the application according to end use, market sector, and market sectors and company headquarters location. The number of companies engaged in activities related to solar collector manufacturing for 1978 through 1980 are listed; and the number of manufacturers and market sector are tabulated for photovoltaic modules manufacturing activities. Names and addresses of manufacturers and importers of solar thermal collectors and manufacturers of photovoltaic solar collectors are included. (WHK)

16711 **(DOE/ET/20413—T1) Design of selective surfaces for solar energy collection.** Trotter, D.M. Jr.; Craighead, H.G.; Sievers, A.J. (Cornell Univ., Ithaca, NY (USA)). 1981. Contract AS03-77ET20413. 13p. NTIS, PC A02/MF A01.

Numerical calculations have been done to determine α/sub THS/, the total hemispherical solar absorptivity, and ϵ/sub TH/, the total hemispherical emissivity in the infrared, of selective surfaces composed of a dielectric film on a metal substrate. The selectivity of the surface as a function of n/sub L/ = n/sub L/ + ik/sub L/, the refractive index of the film, is discussed, as well as the effect of grading the index of the film. It is concluded that the most effective film is one having n/sub L/ as close to unity as possible through its entire thickness while k/sub L/ increases from zero at the front surface to a larger value at the back surface.

16712 **(LA-UR—81-1023) Bonding solar selective absorber foils to glass receiver tubes for use in evacuated tubular collectors: preliminary studies.** Grimmer, D.P.; Avery, J.G. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810509—6). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

The glass receiver tubes used in evacuated tubular collectors are currently vacuum coated with a selective surface in a batch process. Solar-selective absorber foils can be produced successfully by a number of methods and offer economic advantages over batch collector coatings in many instances. Bonding of these foils to a variety of surfaces is done at present with adhesives whose upper temperature limit is about 250°C. However, many absorber coatings are stable to much higher temperatures. Thus, suitable techniques for bonding solar-selective absorber foils to high-temperature (up to 400°C) glass receivers would be desirable. Possible foil-glass bonding techniques and the results of experiments on selected techniques, principally electrical field-assisted bonding and the use of glass sealing frits are described. Foil-bonded samples were thermally cycled in a vacuum to temperatures typical of stagnation in evacuated collectors, and changes in bond strength and foil optical properties were observed. Finally, the economic viability of foil bonding processes is discussed.

16713 **(PB—80-813934) Solar energy concentrator design and operation. 1970-July 1980 (citations from the Engineering Index data base). Report for 1970-July 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1980. 330p. NTIS PC N01/MF N01.

Worldwide research on the design and operation of various types of solar energy concentrators is discussed. Topic areas cover thermal and optical performance of Fresnel lenses, compound parabolic concentrators, fixed mirror concentrators, and planar reflector enhancement of flat plate collector systems. A few abstracts deal with V-trough concentrators and methods to calculate performance of concentrators. A separate Published Search on heliostat systems is available. (This updated bibliography contains 220 citations, 53 of which are new entries to the previous edition.)

16714 **(PB—80-814122) Flat plate solar collector design and performance. 1970-July 1980 (citations from the Engineering Index data base). Report for 1970-July 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1980. 261p. NTIS PC N01/MF N01.

Citations from worldwide literature on the design, thermal performance, and optimization of air- and liquid-type flat plate collectors are covered. Topic areas include heat loss and heat transfer, effect of orientation, corrosion protection, optical coatings, enhancement of performance through the use of planar reflectors, and the effect of honeycomb layers on collector performance. A few studies pertain to grooved, corrugated, or V-trough collectors. Abstracts dealing with methods of measuring the performance of flat plate collectors and computer optimization studies are included. (This bibliography contains 256 citations, 82 of which are new entries to the previous edition.)

16715 **(PB—80-814130) Flat plate solar collector design and performance. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Sep 1980. 165p. NTIS PC N01/MF N01.

Federally-funded research on the design and thermal efficiency of air- and liquid-type flat plate collectors is discussed. Topic areas cover convection characteristics, methods to reduce heat loss, optical coatings, and corrosion control. Emphasis of the bibliography is on basic research studies. (This updated bibliography contains 196 citations, 36 of which are new entries to the previous edition.)

16716 **(SAND—80-1964/10) Midtemperature Solar Systems Test Facility predictions for thermal performance based on test data: Custom Engineering trough with glass reflector surface and Sandia-designed receivers.** Harrison, T.D. (Sandia National Labs., Albuquerque, NM (USA)). May 1981. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01.

Thermal performance predictions based on test data are presented for the Custom Engineering trough and Sandia-designed receivers, with glass reflector surface, for three output temperatures at five cities in the United States. Two experimental receivers were tested, one with an antireflective coating on the glass envelope around the receiver tube and one without the antireflective coating.

16717 **(SAND—80-2504C) Operating experience at the Central Receiver Test Facility (CRTF).** Holmes, J.T.; Bell, W.K.; King, D.L.; Matthews, L.K.; Seamons, L.O. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 10p. (CONF-810509—13). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

The CRTF, constructed to develop solar central receiver components, began operation in October, 1978. To date, three solar receivers that used either air, water/steam, or a molten nitrate salt as their working fluid have been successfully characterized. Also, seven heliostat concepts have been evaluated. These included two competing designs for the 10 MWe solar pilot plant now under construction near Barstow, California, a privately sponsored design, and four advanced designs. Almost three years of operation of the CRTF have provided data and experience on the performance and maintenance requirements for typical components of a solar central receiver system.

16718 **(SAND—80-7076) Full-scale load tests of experimental solar-collector foundations.** Merkle, D.H. (Applied Research Associates, Inc., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 36p. (CONF-810341—1). NTIS, PC A03/MF A01.

From ASCE spring conference; Las Cruces, NM, USA (27 Mar 1981).

Four drilled, reinforced concrete piers, typical of foundations utilized for single-axis-tracking solar collector systems, were tested to failure under both eccentric lateral and vertical loads. Previously developed equations for lateral and vertical load capacity

yielded reasonable predictions, but the tests disclosed the need to improve the foundation anchor bolt assembly, and possibly also the method of mounting the collectors to the foundations. Nevertheless, the lateral and vertical failure loads and moments of all four piers well exceeded specified design values.

16719 **(SAND—81-8665) Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts.** Goods, S.H. (Sandia National Labs., Livermore, CA (USA)). Mar 1981. Contract AC04-76DP00789. 30p. NTIS, PC A03/MF A01.

Incoloy Alloy 800 (I800) has been proposed for use in the receiver tube panel arrays in a number of advanced solar central receiver (SCR) concepts. Because of their high heat capacity and high thermal energy density, several designs require the use of molten sodium and potassium nitrate salt mixture to act as the cooling or heat transfer fluid. The effects of deformation on the corrosion resistance of Incoloy Alloy 800 in sodium nitrate and potassium nitrate salt mixtures have been studied. Hollow tube specimens filled with the salt mixture (60%-$NaNO_3$-40% KNO_3) were tested in constant load tension creep at elevated temperatures (550° ≦ T ≦ 670°C). Depending on the temperature and initial stress, fracture times (and therefore salt exposure times) ranged between 300 and 1000 hours. While the fracture strain of specimens tested to failure was only slightly reduced when exposed to the salt environment, metallographic observations of polished cross-sections revealed severe surface oxidation. In order to characterize the effect of total imposed strain on oxide morphology a number of creep tests were terminated prior to fracture. Increasing deformation resulted in a more extensively damaged surface oxide as well as a more rapid rate of corrosion. EDX analysis revealed that the oxide was multiphase, with a near surface iron rich oxide above a chromium-rich oxide layer. Below 630°C the oxide-metal interface was well defined (although irregular). Above 630°C the interface was more diffuse with fine oxide intrusions growing into the base metal and small particles of the alloy visible in the oxide near the base metal interface.

16720 **(UCRL—15329) Applications of shallow solar ponds in wastewater treatment.** Goebel, R.P. (Lawrence Livermore National Lab., CA (USA)). 31 Oct 1979. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01.

The Shallow Solar Pond (SSP) has been developed as a means of supplying solar heated water for industrial and commercial use. Potential applications of the SSP in wastewater treatment are investigated. The key findings of this study are: the only near term application of SSP's which involves significant amounts of energy is that of heating anaerobic digesters. Because of the economies of scale, only large systems (≧ 1 acre) can be justified. The digester gas displaced by the SSP must be assigned a value close to that of conventional gaseous fuels. Sludge preheating, rather than digester maintenance heating, is the most cost effective use of SSP heat. In the industrial and food processing sector, there exists significant potential for using anaerobic processes to treat medium and high strength wastes.

16721 **Black chromium-molybdenum: a new stable solar absorber.** Smith, G.B.; Ignatiev, A. (Univ. of Houston, TX). *Solar Energy Materials ;* 4: No. 2, 119-133(Jan 1981).

A new solar selective black which is more stable at high temperatures in air than standard black chrome has been electrodeposited. It is based on two refractory metals and their oxides, chromium and molybdenum. Their micromorphology is the same as found in black chrome and the solar absorption mechanisms are similar. Plating mechanisms are discussed and related to film structure. Chemical structure via X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) as a function of depth reveal important differences to the structure of standard black chrome which affect stability but not optical response before heating. Absorptance is stable at a value of 0.95 to at least 425°C in air in the best composites which have Mo/Cr ratios of about 0.05. The molybdenum is not present as metal and the total metallic Cr content decreases as the Mo content increases. The Mo percentage is very high near the surface of the film.

16722 **Evaluation of silicone foam for flat plate solar collector insulation.** Rabe, J.A.; Spells, S.; Rasch, D.M.; Homan, G.R.; Lee, C.L. (Dow Corning Corp., Midland, MI). *Solar Energy Materials ;* 4: No. 2, 159-168(Jan 1981).

An experimental 50 kg m^{-3} silicone foam has been evaluated for use as insulation in flat plate solar collectors. Its thermal conductivity, thermal stability, flame resistance, weatherability and physical strength have been characterized. Also, a solar collector containing silicone insulation and another collector containing a silicone foam/isocyanurate foam composite insulation have been put through a stagnation exposure test. The results indicate that both the all-silicone insulation and the composite insulation can withstand the conditions in a stagnant collector without structural degradation or the outgassing often encountered when conventional insulating materials are used.

16723 **Method of making reflecting film reflector.** Cottingham, J.G. (to Department of Energy). US Patent 4,226,657. 7 Oct 1980. Filed date 17 May 1978. vp.

PAT-APPL-906820.

A reflector of the reflecting film type is disclosed and which may be used in a heliostatic system for concentrating solar energy and comprising a reflecting film bonded to an appropriate rigid substrate in such a way that specularity of a very high order is achieved. A method of bonding the reflecting film to the substrate is also disclosed and comprises the steps of initially adhering the film to a smooth, clean flat rigid surface with a non-bonding liquid between the rigid surface and film, and then bonding the substrate and film. The non-bonding liquid has a molecular adhesion greater than any stresses due to handling or curing of the bonding agent which is applied between the film and the opposing surface of the rigid substrate.

1420 Heat Storage

16724 **(ANL—80-8) COMMIX-SA-1: a three-dimensional thermohydrodynamic computer program for solar applications.** Sha, W.T.; Lin, E.I.H.; Schmitt, R.C.; Liu, K.V.; Hull, J.R.; Oras, J.J. Jr.; Domanus, H.M. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 49p. NTIS, PC A03/MF A01.

COMMIX-SA-1 is a three-dimensional, transient, single-phase, compressible-flow, component computer program for thermohydrodynamic analysis. It was developed for solar applications in general, and for analysis of thermocline storage tanks in particular. The conservation equations (in cylindrical coordinates) for mass, momentum, and energy are solved as an initial-boundary-value problem. The detailed numerical-solution procedure based on a modified ICE (Implicit Continuous-Fluid Eulerian) technique is described. A method for treating the singularity problem arising at the origin of a cylindrical-coordinate system is presented. In addition, the thermal interactions between fluid and structures (tank walls, baffles, etc.) are explicitly accounted for. Finally, the COMMIX-SA-1 code structure is delineated, and an input description and sample problems are presented.

16725 **(CONF-810509—1) Longterm solar heat storage (abstract).** Borst, W.L. (Southern Illinois Univ., Carbondale (USA). Dept. of Physics and Astronomy). 1981. Contract FG02-79R510106. 3p. NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

The longterm storage of solar heat in a large underground water cistern was studied during summer and fall 1980. The existing underground cistern (9200 gallons or 35,000 kg water) was retrofitted with sprayed-on urethane insulation of 0.15 m (6 in.) average thickness. Heat collection was accomplished with a site-built solar collector using Roll-bond absorbers and a double-glazed cover. The heat was transferred from the collector to the nearby storage cistern in a closed loop system containing a heat exchanger in the cistern. Organic heat transfer fluid was used in the loop in order to avoid boiling and freezing problems. Particular emphasis in the present study was put on the interactions between the cistern storage and the surrounding soil by monitoring soil temperatures at various depths. (MHR)

16726 **(SERI/TR—751-793) Solar energy storage researchers information user study.** Belew, W.W.; Wood, B.L.; Marle, T.L.; Reinhardt, C.L. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 213p. NTIS, PC A10/MF A01.

The results of a series of telephone interviews with groups of users of information on solar energy storage are described. In the current study only high-priority groups were examined. Results from 2 groups of researchers are analyzed: DOE-Funded Researchers and Non-DOE-Funded Researchers. The data will be used as input to the determination of information products and services the Solar Energy Research Institute, the Solar Energy Information Data Bank Network, and the entire information outreach community should be preparing and disseminating.

15 GEOTHERMAL ENERGY

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 16738

16727 **(DOE/ET/28392—31) Structural fabric and in-situ stress analyses of the Roosevelt Hot Springs KGRA.** Yusas, M.R.; Bruhn, R.L. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Nov 1979. Contract AC07-78ET28392. 67p. NTIS, PC A04/MF A01.

The Roosevelt Hot Springs Known Geothermal Resource Area (KGRA) is a hot-water dominated system in fractured plutonic and metamorphic rock. A principal purpose of this study was to determine the geometry and origin of fractures as an aid to developing a structural model for the reservoir. The results may also be useful for the design of hydrofracture experiments at the Roosevelt KGRA. Three major normal fault trends are present in the Mineral Mountains. North-northeast trending faults, including the Opal Mound Fault, form the center of low electrical resistivity and high heat flow anomalies. Major east-west trending structures such as the Hot Springs Fault form structural boundaries for the geothermal reservoir. A set of northwest trending faults also occurs in the KGRA. Structural analysis was conducted by field mapping of joints, small shear zones, and dikes. Three major styles of fracturing have been identified.

16728 **(SAND—80-1959) Geology of magma systems: background and review.** Peterfreund, A.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 74p. NTIS, PC A04/MF A01.

A review of basic concepts and current models of igneous geology is presented. Emphasis is centered on studies of magma generation, ascent, emplacement, evolution, and surface or near-surface activity. An indexed reference list is also provided to facilitate future investigations.

1503 Geothermal Exploration And Exploration Technology

16729 **(DOE/ET/27002—1) Interactive modeling system for 2-D magneto-telluric and line source resistivity data (MT2D users guide and documentation).** Nutter, C. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Sep 1979. Contract AC07-79ET27002. 184p. NTIS, PC A09/MF A01.

A two-dimensional finite element program developed at the University of Utah has been described by John Stodt. This program handles the two-dimensional magneto-telluric TE and TM mode problems, as well as the infinite line source problem. This supplement to Stodt's report describes an interactive modeling system which incorporates Stodt's program. This system was patterned after an interactive modeling system for dipole-dipole and IP resistivity. The interactive modeling system is a set of programs and subprograms, with a single logical entry and a single logical exit, which allows the user to manipulate model parameters, execute the finite element program, and display output. Five distinct logical functions are available to the user. These five functions are shown in the block diagram of the interactive system.

16730 **(DOE/ET/27002—2) Documentation and analysis of the Schlumberger interactive 1-D inversion program slumb.** Sandberg, S. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Sep 1979. Contract AC07-79ET27002. 89p. NTIS, PC A05/MF A01.

This computer program is designed to accept field data from a Schlumberger resistivity array and invert it in terms of a one-dimensional layered geoelectrical model. Because the inverse problem is non-linear, an initial guess model is required. This input model can be obtained by traditional curve matching, or by repeated use of a forward algorithm. This program was written in FORTRAN V and developed on a UNIVAC 1108 computer.

16731 **(DOE/ET/28392—23) Induced-polarization measurements at Roosevelt Hot Springs Thermal area, Utah.** Chu, J.J.; Sill, W.R.; Ward, S.H. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Jun 1979. Contract AC07-78ET28392. 45p. NTIS, PC A03/MF A01.

An induced polarization survey was conducted at Roosevelt Hot Springs, using the dipole-dipole array. The survey consisted of two profile lines, one across the southern end of the system (2200N) and another across the northern portion (5950N). A total of 15 line-km of profiles was run, with 100 m and 300 m dipoles out to n spacings of 4 to 6. Apparent resistivity amplitude and phase data were gathered with a phase-sensitive receiver at frequencies between 32 Hz and 1/256 Hz. The data are presented in the form of apparent resistivity of phase pseudosections. Induced polarization effects in geothermal environments can result from clays and pyrite which are associated with hydrothermal alteration. Laboratory measurements on altered material show some induced polarization effects at frequencies below 1 Hz which are thought to be due to pyrite. A higher frequency polarization (> 1 Hz) is attributed to the effects of clays. The primary purpose of this survey was to investigate the feasibility of mapping clay alteration zones, and separating them from other conductive features, by making use of their polarization characteristics. The field data show some small, low frequency phase anomalies which may be the result of pyrite deposition. The higher frequencies show considerable phase effects, which can be the result of clays, but the effects of electromagnetic coupling have not, as yet, been assessed.

16732 **(DOE/ET/28392—25) Telluric-magnetotelluric method in two- and three-dimensional environments.** Stodt, J.A.; Hohmann, G.W.; Ting, S.C. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Aug 1979. Contract AC07-78ET28392. 53p. NTIS, PC A04/MF A01.

Through two- and three-dimensional computer modeling we have shown that the assumption of spatial uniformity of the horizontal magnetic field, which is an implicit assumption made in straightforward applications of the telluric-magnetotelluric (T-MT) method, is not always valid near conductivity inhomogeneities. For a two-dimensional case, the TE mode horizontal magnetic field may vary as much as a factor of three in five kilometers. The spatial variation of the horizontal magnetic field is not as great over three-dimensional inhomogeneities, but may still contribute significantly to impedance magnitude and phase over shallow inhomogeneities at higher frequencies. Spatial variation of the horizontal magnetic field can cause T-MT impedances to differ significantly from magnetotelluric (MT) impdances. Consequently, MT modeling of T-MT field data could result in a misleading interpretation of conductivity structure. To avoid erroneous interpretation, numerical modeling programs should calculate actual T-MT responses, rather than MT responses, for comparison with T-MT data. Resolution of a conductivity structure which produces significant spatial variation of the magnetic field is less with T-MT data than with an equal amount of MT data. However, the increased amount of data one obtains from a T-MT survey may offset this shortcoming if the data are properly interpreted.

16733 **(DOE/ET/28392—32) Evaluation of hypocenter location techniques with applications to southern Utah: regional earthquake distributions and seismicity of geothermal areas.** Wechsler, D.J.; Smith, R.B. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Dec 1979. Contract AC07-78ET28392. 143p. NTIS, PC A07/MF A01.

Three techniques for the computation of earthquake hypocenter locations were compared through empirical results of syn-

thetic test cases utilizing four different computer programs. The three approaches: (1) the single event method, (2) the master event method, and (3) the joint hypocenter determination method, were analyzed with respect to their application to regional (epicenter-to-station distances from 10 to 500 km) and local (epicentral distances from 0 to 70 km) seismic network recording situations. It was found that the joint hypocenter technique can significantly correct for inadequacies in assumed velocity models by simultaneous computation of station adjustments. Earthquakes located using the joint hypocenter technique are located more precisely with respect to each other. The joint epicenter location technique was then applied to relocations of epicenters in southern Utah below 40°N latitude with the intent of resolving some spatial relationships of epicenter occurrence on this regional scale. Earthquakes in Utah occur in a diffuse zone 150 km to 200 km wide that coincides with the physiographic boundary of the Colorado Plateau. Swarm activity is prevalent where the zone changes from a north-south to a southwest orientation, but except for a cluster northwest of Cedar City, the only major alignments of epicenters are north-south.

16734 **(DOE/ID/12079—21) Trace-element geochemistry of gradient hole cuttings: Beowawe geothermal area, Nevada.** Christensen, O.D. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Dec 1980. Contract AC07-79ID12079. 32p. (ESL—48). NTIS, PC A03/MF A01.

Multielement geochemical analysis of drill cuttings from 26 shallow temperature-gradient drill holes and of surface rock samples reveals trace element distributions developed within these rocks as a consequence of chemical interaction with thermal fluid within the Beowawe geothermal area. The presently discharging thermal fluids are dilute in all components except silica, suggesting that the residence time of these fluids within the thermal reservoir has been short and that chemical interaction with the reservoir rock minimal. Interaction between these dilute fluids and rocks within the system has resulted in the development of weak chemical signatures. The absence of stronger signatures in rocks associated with the present system suggests that fluids have had a similar dilute chemistry for some time. The spatial distribution of elements commonly associated with geothermal systems, such as As, Hg and Li, and neither laterally nor vertically continuous. This suggests that there is not now, nor has there been in the past, pervasive movement of thermal fluid throughout the sampled rock but, instead, that isolated chemical anomalies represent distinct fluid-flow chanels. Discontinuous As, Li and Hg concentrations near White Canyon to the east of the presently active surface features record the effects of chemical interaction of rocks with fluids chemically unlike the presently discharging fluids. The observed trace element distributions suggest that historically the Beowawe area has been the center of more than one hydrothermal event and that the near-surface portion of the present hot-water geothermal system is controlled by a single source fracture, the Malpais Fault, or an intersection of faults at the sinter terrace.

16735 **(DOE/ID/12079—24) Geochemistry of selected rock samples: Colado geothermal area, Nevada.** Christensen, O.D.; Sibbett, B.S.; Bullett, M.J. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jan 1981. Contract AC07-79ID12079. 21p. (ESL—50). NTIS, PC A02/MF A01.

The results of the chemical analysis of 30 surface rock samples from the Colado geothermal area are presented. The samples represent a variety of materials affected by several hydrothermal events which have formed Au, Sb and clay deposits within the area. The active geothermal system is currently being evaluated for electrical power production. The elements As, Sb, Au, Ag, Li and Hg have been concentrated during more than one of the hydrothermal events which have affected the Colado area. Distinct chemical signatures do not exist for any particular event, instead, it appears that this suite of elements has been repeatedly remobilized, probably in response to similar physical and chemical conditions and processes. Delineation of geochemical zoning related to the active geothermal system is possible only because it is spatially separated from the older hydrothermal deposits. The chemical similarity between the older hydrothermal events and the present hydrothermal system suggest that the Sb and Au mineralization formed at shallow depths in a boiling geothermal environment. It is suggested that new ore zones may be discovered in the Willard mining district if the geothermal model is applied to exploration.

16736 **(DOE/ID/12079—29) Geophysical investigations of the Baltazor Hot Springs known geothermal resource area and the Painted Hills thermal area, Humboldt County, Nevada.** Edquist, R.K. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Feb 1981. Contract AC07-79ID12079. 101p. (ESL—54). NTIS, PC A06/MF A01.

Geophysical investigations of the Baltazor Hot Springs KGRA and the Painted Hills thermal area, Humboldt Co., Nevada are described. The study includes a gravity survey of 284 stations covering 750 sq km, numerical modeling and interpretation of five detailed gravity profiles, numerical modeling and inerpretation of 21.8 line-km of dipole-dipole electrical resistivity data along four profiles, and a qualitative inerpretation of 38 line-km of self-potential data along eight profiles. The primary purpose of the investigation is to try to determine the nature of the geologic controls of the thermal anomalies at the two areas.

16737 **(LA—8676-T) Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau.** Ander, M.E. (Los Alamos Scientific Lab., NM (USA)). Mar 1981. Contract W-7405-ENG-36. 235p. NTIS, PC A11/MF A01.

Thesis.

As part of the national hot dry rock (HDR) geothermal program conducted by Los Alamos Scientific Laboratory, a regional deep magnetotelluric (MT) survey of Arizona and New Mexico was performed. The main objective of the MT project was to produce a regional geoelectric contour map of the pervasive deep electrical conductor within the crust and/or upper mantle beneath the Colorado Plateau, Basin and Range Province, and Rio Grande rift. Three MT profiles cross the Jemez lineament. Preliminary one-dimensional analysis of the data suggest the lineament is associated with anomalously high electrical conductivity very shallow in the crust. An MT/audiomagnetotelluric (AMT) study of a 161 km^2 HDR prospect was performed on the Zuni Indian Reservation, New Mexico. Two-dimensional gravity modeling of a 700-km gravity profile at 34°30'N latitude was used to study the crust and upper mantle beneath the Rio Grande rift. Several models of each of three consecutive layers were produced using all available geologic and geophysical constraints. Two short-wavelength anomalies along the gravity profile were analyzed using linear optimization techniques.

16738 **(LA—8710-HDR) Preliminary Hot Dry Rock geothermal evaluation of Long Valley Caldera, California.** Gambill, D.T. (Los Alamos National Lab., NM (USA)). Mar 1981. Contract W-7405-ENG-36. 26p. NTIS, PC A03/MF A01.

Long Valley Caldera, formed during the catastrophic eruption of the Bishop Tuff 0.7 Myr ago, straddles the border between the Sierra Nevada and the Basin and Range tectonic provinces in eastern California. The caldera contains rhyolitic to basaltic flows, tuffs, and domes from 3.2 Myr to 450 yr old. Sierra Nevada frontal faults intersect the northwest and southeast parts of the caldera. The dominant feature within the caldera is a resurgent dome in the west-central section, which formed between about 0.7 and 0.5 Myr b.p. Teleseismic data indicate a low P-wave velocity zone below the western part of the caldera, indicating a magma chamber between 7 and 25 km depth. This conclusion is supported by gravity data. Heat flow just west of the caldera is 3.75 HFU. Just east of the caldera, measured heat flow is about 2 HFU. However, a deep well on the eastern edge of the resurgent dome has a gradient of 38°C/km from 0.66 to 1.2 km suggesting that the magma chamber, which produced Long Valley, is largely crystallized below the resurgent dome. The high heat flow beneath the western caldera may be a manifestation of shallow silicic magma associated with the recent Inyo Craters. These data indicate a smaller magma source may lie below the western caldera. The resurgent dome and the area just west of the caldera are cited for additional Hot Dry Rock prospection. The higher temperature gradient and lack of caldera fill beyond the west margin of the caldera combine to make this area promising for future HDR evaluation.

16739 **(LBL—12012) Electromagnetic (EM-69) survey of the McCoy geothermal prospect, Nevada.** Wilt, M.; Haught, R.; Goldstein, N.E. (Lawrence Berkeley Lab., CA (USA)). Dec 1980. Contract W-7405-ENG-48. 117p. NTIS, PC A06/MF A01.

A frequency-domain electromagnetic survey was conducted at 19 stations over a 200 km^2 area encompassing the McCoy geothermal prospect, Churchill County, central Nevada. The McCoy area is characterized by high heat flow, mercury mineralization, and recent volcanics. Three horizontal-loop transmitters were used with receivers from 0.5 to more than 4.0 km from the loops. Receiver stations were arranged along a pair of crossing north-south and east-west lines. Data were interpreted first with a simple apparent resistivity formula and then with a least-squares lumped-model inversion program. The rough terrain and complex geology introduce an element of uncertainty to the interpretations.

16740 **(NP—25335) Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico.** Landis, G.P.; Logsdon, M. (New Mexico Univ., Albuquerque (USA). Dept. of Geology). Nov 1980. 199p. (EMD—78-2120). New Mexico Energy and Minerals Department, Sante Fe.

The reseach objective is to develop a series of computer-based chemical modeling programs in order to conduct detailed interpretive studies of the mass of geochemical data obtained during previous studies of geothermal systems in New Mexico. The software development and basic applications to the project objectives are described. A geochemical study of the Lightning Dock KGRA, Hidalgo County, New Mexico is discussed. Computer programs were developed or adapted to perform the following three basic computations: (1) geochemical reservoir temperatures; (2) geothermal water mixing models; and (3) water/rock reactions path calculations. All programs were developed in FORTRAN IV for use on a PDP 11/MNC computer. (MHR)

16741 **(NP—25336) Seismic exploration for shallow magma bodies in the vicinity of Socorro, New Mexico. Final report, January 1, 1977-December 31, 1977.** Sanford, A.R.; Schlue, J. (New Mexico Inst. of Mining and Technology, Socorro (USA). Dept. of Geoscience). Nov 1980. 200p. (EMD—76-263). New Mexico Energy and Minerals Department, Santa Fe.

This report contains the following articles: Characteristics of Rio Grande rift in vicinity of Socorro, New Mexico, from geophysical studies; Exploration framework of the Socorro Geothermal Area, New Mexico; a study of Poisson's ratio in the upper crust in the Socorro, New Mexico, Area; and Microearthquake frequency attenuation of S phases in the Rio Grande rift near Socorro. (ACR)

16742 **(NVO—230) Old Maid Flat geothermal exploratory hole No. 7A drilling and completion report.** (Fenix and Scisson, Inc., Las Vegas, NV (USA)). Feb 1981. 52p. NTIS, PC A04/MF A01.

Drilling and testing efforts for a 6000-foot geothermal exploratory hole on the western approaches to Mount Hood, near Portland, Oregon were completed. The intent of the drilling was to encounter a hydrothermal reservoir in a postulated fracture system and confirm the existence of a moderate-temperature (200°F) geothermal resource in the Old Main Flat (OMF) vicinity of Mount Hood. The exploratory hole, OMF No. 7A, was completed to a total depth of 6027 feet in 54 days using conventional rotary drilling techniques. The hole was found to be incapable of producing fluids with the desired temperatures. A maximum hole temperature of about 235°F was recorded at total depth and a temperature gradient of about 3.3°F/100 feet was exhibited over the lower 1000 feet of hole. A variety of technical data, including physical samples such as cores, cuttings, and borehole fluids, plus geophysical well logs were acquired. Data analyses are continuing, with results to be made available through future separate reports.

16743 **(SAND—81-0021) Geopressured geothermal drilling and completions technology development needs.** Maish, A.B. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 119p. NTIS, PC A06/MF A01.

Geopressured geothermal formations found in the Texas and Louisiana gulf coast region and elsewhere have the potential to supply large quantities of energy in the form of natural gas and warm brine (200 to 300°F). Advances are needed, however, in hardware technology, well design technology, and drilling and completion practices to enable production and testing of exploratory wells and to enable economic production of the resource should further development be warranted. This report identifies needed technology for drilling and completing geopressured geothermal source and reinjection wells to reduce the cost and to accelerate commercial recovery of this resource. A comprehensive prioritized list of tasks to develop necessary technology has been prepared. Tasks listed in this report address a wide range of technology needs including new diagnostic techniques, control technologies, hardware, instrumentation, operational procedure guidelines and further research to define failure modes and control techniques. Tasks are organized into the functional areas of well design, drilling, casing installation, cementing, completions, logging, brine reinjection and workovers.

1504 Legal And Institutional Aspects

REFER ALSO TO CITATION(S) 16746

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 16761

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 16746, 17353, 17457

16744 **(P—700-81-002) Sacramento Municipal Utility District Geothermal Power Plant, SMUDGEO No. 1. Final report.** (Sacramento Municipal Utility District, CA (USA)). Feb 1981. 316p. California Energy Commission, Sacramento.

The proposed construction of 72-MW geothermal power plant is discussed. The following aspects are covered: the project as proposed by the utility; the environmental setting; the adverse consequences of the project, any significant environmental effects which cannot be avoided, and any mitigation measures to minimize significant effects; the potential feasible alternatives to the proposed project; the significant unavoidable, irreversible, and long-term environmental impacts; and the Growth Inducing Impacts. (MHR)

16745 **(UCRL—13897(Rev.1)) Potential impacts of geothermal development on outdoor recreational use of the Salton Sea.** Twiss, R.; Sidener, J.; Bingham, G.; Burke, J.E.; Hall, C.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 61p. NTIS, PC A04/MF A01.

This study analyzes the consequences that full-field development of geothermal resources may have on recreational industry and aesthetic resources in Imperial Valley. Significant changes in the level of the Salton Sea and extensive development of outlying desert areas, such as East Mesa, resulting from geothermal development will significantly affect fishing and water-oriented sports, wildlife refuges, and off-road vehicle activity in East Mesa. The aesthetic impacts are illustrated by the use of pencil sketches of views organized in sectors around the Salton Sea. The sketches allow selection and emphasis of important detail not obtainable with the use of photographs or viewshed analyses. Generally, the aesthetic impacts of geothermal development are superimposed on an environment already affected by rural development, some industrialization, and highly intensive agricultural activity. Power plant structures, transmission lines, and, to some extent, water and steam pipelines are a noticeable addition to the local visual scene but do not significantly alter the aesthetics now dominated by man's activi-

ty. In the wildlife refuge areas of Niland and on exposed ridgelines, however, there is a potential for significant aesthetic impact. The aesthetic impacts can be mitigated to some extent in these areas by location and design choices and by clustering the geothermal plants. In addition, housing and commercial development to support direct and indirect population growth will create a variety of aesthetic impacts of varying beneficial and detrimental character in different locales throughout the valley. Several community design concepts are proposed to accommodate this residential development.

1508 Geothermal Power Plants

REFER ALSO TO CITATION(S) 16744

16746 **(P—800-80-013) Commission decision on the Department of Water Resources' Application for Certification for the Bottle Rock Geothermal Project.** (California Energy Commission, Sacramento (USA)). Nov 1980. 327p. California Energy Commission, Sacramento.

Portions of document are illegible.

The Application for Certification for the construction of a 55 MW geothermal power plant and related facilities in Lake County was approved subject to terms identified in the Final Decision. The following are covered: findings on compliance with statutory site-certification requirements; final environmental impact report; procedural steps; evidentiary bases; need, environmental resources; public health and safety; plant and site safety and reliability; socioeconomic, land use, and cultural concerns, and transmission tap line. (MHR)

16747 **International developments in geothermal power.** DiPippo, R. (Southeastern Massachusetts Univ., North Dartmouth). *ASTM (American Society for Testing and Materials) Standardization News ;* 7: No. 10, 19-28(Oct 1979).

The status of geothermal electric power generation throughout the world is reviewed. A tabular summary of installed geothermal power capacity is given for eleven countries. A closer look is taken at the activities in Italy, New Zealand, Japan, and the United States. Examples of the most recent projects are described and illustrated with flow diagrams and site photographs. Some of the unsolved technical problems facing the geothermal industry are pointed out.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 16742

16748 **(BNL—51287) Polymer-cement geothermal-well-completion materials. Final report.** Zeldin, A.N.; Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH00016. 88p. NTIS, PC A05/MF A01.

A program to develop high-temperature polymer cements was performed. Several formulations based on organic and semi-inorganic binders were evaluated on the basis of mechanical and thermal stability, and thickening time. Two optimized systems exhibited properties exceeding those required for use in geothermal wells. Both systems were selected for continued evaluation at the National Bureau of Standards and contingent upon the results, for field testing in geothermal wells.

16749 **(DOE/AL/10563—T8(Vol.1)) Geothermal fracture stimulation technology. Volume 1. Fracturing proppants and their properties.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). Jul 1980. Contract AC32-79AL10563. 97p. NTIS, PC A05/MF A01.

A review of previously published literature on proppant permeability is presented. This data will be used in the subsequent phases of the geothermal stimulation project. Much information comes from the oil and gas industry which has tested various proppants during the past thirty years over a range of different closure stresses at the lower temperatures found in oil reservoirs. The historical development of proppants is summarized and reviewed and a variety of data on proppants found in today's literature is presented. Also included are several standard test procedures and equipment setups used in measuring proppant properties and in proppant testing.

16750 **(DOE/AL/10563—T8(Vol.2)) Geothermal fracture stimulation technology. Volume II. High-temperature proppant testing.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). Jul 1980. Contract AC32-79AL10563. 81p. NTIS, PC A05/MF A01.

Data were obtained from a newly built proppant tester, operated at actual geothermal temperatures. The short term test results show that most proppants are temperature sensitive, particularly at the higher closure stresses. Many materials have been tested using a standard short-term test, i.e., fracture-free sand, bauxite, and a resin-coated sand retained good permeability at the high fluid temperatures in brine over a range of closure stresses. The tests were designed to simulate normal closure stress ranges for geothermal wells which are estimated to be from 2000 to 6000 psi. Although the ultra high closure stresses in oil and gas wells need not be considered with present geothermal resources, there is a definite need for chemically inert proppants that will retain high permeability for long time periods in the high temperature formations.

16751 **(DOE/AL/10563—T8(Vol.3)) Geothermal fracture stimulation technology. Volume III. Geothermal fracture fluids.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). Jan 1981. Contract AC32-79AL10563. 195p. NTIS, PC A09/MF A01.

A detailed study of all available and experimental frac fluid systems is presented. They have been examined and tested for physical properties that are important in the stimulation of hot water geothermal wells. These fluids consist of water-based systems containing high molecular weight polymers in the uncrosslinked and crosslinked state. The results of fluid testing for many systems are summarized specifically at geothermal conditions or until breakdown occurs. Some of the standard tests are ambient viscosity, static aging, high temperature viscosity, fluid-loss testing, and falling ball viscosity at elevated temperatures and pressures. Results of these tests show that unalterable breakdown of the polymer solutions begins above 300°F. This continues at higher temperatures with time even if stabilizers or other high temperature additives are included.

16752 **(DOE/AL/10563—T8(Vol.4)) Geothermal fracture stimulation technology. Volume IV. Proppant analysis at geothermal conditions.** (Republic Geothermal, Inc., Santa Fe Springs, CA (USA)). Jan 1981. Contract AC32-79AL10563. 59p. NTIS, PC A04/MF A01.

Crushing and degradation mechanisms of proppants are examined to characterize proppants and assess their usability in geothermal wells. Short-term tests can tell the physical strength of a proppant, but long-term tests are required to ascertain any interrelated chemical effects. Degradation of proppants is measured as a loss in permeability and can be correlated to temperature, time, and closure stress. Sand is a common proppant which is strongly affected by higher temperature and closure stress. Even at low stress levels, sand degrades in brine or hot water with long-term exposure. Most geothermal waters and their pH levels can also be detrimental to sand. There are some proppants with desirable properties at geothermal conditions. These are resistant to the crushing loads or closure stress in geothermal wells and will not react or dissolve in high temperature brines. While there are limits to these proppants, an unqualified list of possible geothermal proppants is given: aluminum oxide, garnet, resin-coated proppants, and sintered bauxite.

16753 **(LBL—12220) Well-bore effects in the analysis of two-phase geothermal well tests.** Miller, C.W.; Benson, S.; O'Sullivan, M.J.; Pruess, K. (Lawrence Berkeley Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 17p. (CONF-810321—3). NTIS, PC A02/MF A01.

From SPE California regional meeting; Bakersfield, CA, USA (25 Mar 1981).

A method of designing and analyzing pressure transient well tests of two-phase (steam-water) reservoirs is given. Wellbore stor-

age is taken into account and the duration of it is estimated. It is shown that the wellbore flow can completely dominate the downhole pressure signal such that large changes in the downhole pressure that might be expected because of changes in kinematic mobility are not seen. Changes in the flowing enthalpy from the reservoir can interact with the wellbore flow so that a temporary plateau in the downhole transient curve is measured. Application of graphical and non-graphical methods to determine reservoir parameters from drawdown tests is demonstrated.

16754 **(SAND—79-1592C) Recent developments in polycrystalline diamond-drill-bit design.** Huff, C.F.; Varnado, S.G. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 29p. (CONF-800204—11). NTIS, PC A03/MF A01.

From Energy-sources technology conference; New Orleans, LA, USA (3 Feb 1980).

Development of design criteria for polycrystalline diamond compact (PDC) drill bits for use in severe environments (hard or fractured formations, hot and/or deep wells) is continuing. This effort consists of both analytical and experimental analyses. The experimental program includes single point tests of cutters, laboratory tests of full scale bits, and field tests of these designs. The results of laboratory tests at simulated downhole conditions utilizing new and worn bits are presented. Drilling at simulated downhole pressures was conducted in Mancos Shale and Carthage Marble. Comparisons are made between PDC bits and roller cone bits in drilling with borehole pressures up to 5000 psi (34.5 PMa) with oil and water based muds. The PDC bits drilled at rates up to 5 times as fast as roller bits in the shale. In the first field test, drilling rates approximately twice those achieved with conventional bits were achieved with a PDC bit. A second test demonstrated the value of these bits in correcting deviation and reaming.

16755 (SAND—79-7117, pp 27-40) **Geothermal drilling fluid testing system.** Reid, K.; Murphy, R.; Hossain, K.; Walter, K.; Ortman, D.; Jamison, D. Jan 1980.

In Workshop on geothermal drilling fluids.

The basic purpose of the Geothermal Drilling Fluid Testing System (GDFTS) is to allow measurement of fluid properties ranging up to 700°F. and 20,000 psi. Measurement of these properties will facilitate development of new drilling fluids to withstand these extreme conditions. Mator fluid properties to be measured are rheology, filtration characteristics, density and corrosivity. Currently used drilling fluids break down as the temperature increases, and the GDFTS will monitor the effect of this breakdown upon the properties. A possible layout of the GDFTS laboratory is shown. In its center is a pit which houses the pressure vessel. Inside the vessel are the drilling fluid and testing devices, which are described. The microcomputer control system is shown in a block diagram. (MHR)

16756 **(SAND—80-0410) Analysis of failed Stratapax-steel stud cutter elements.** Pope, L.E. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1981. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01.

Stratapax-steel stud bond strengths were evaluated in a quality control test fixture at loads up to 410 MPa. No failures occurred for cutter elements bonded in the first six diffusion bond runs. In the next two bond runs, Stratapax-steel stud cutter elements failed at test loads significantly less than 410 MPa. A failure analysis was performed on several of the failed cutter elements to isolate the material weakness responsible for the low load failures. Three groups of failures were identified: a cobalt depletion region on and immediately beneath the cemented carbide surface of the as-received Stratapax blanks, surface contamination at the carbide-steel bond joint and a weakness within the seel stud near the bond joint. Two additional defects were observed which were of some concern, namely, lamination line defects within the carbide portion of Stratapax blanks and severe grind damage on carbide surfaces of as-received Stratapax blanks. It was recommended that a grind schedule be included as part of the specimen preparation prior to bonding to alleviate the observed failures.

16757 **(SAND—80-7136) Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits.** Hendrickson, R.R.; Winzenried, R.W.; Jones, A.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Feb 1981. Contract AC04-76DP00789. 114p. NTIS, PC A06/MF A01.

Research to facilitate the upgrading of conventional unsealed and sealed roller-cone rock bits for geothermal service is presented. Experimental and conventional unsealed bits were subjected to laboratory drilling tests at 250°C (482°F). Bearing life was extended 50% for the experimental bits. Seals and lubricants were developed specifically for sealed, journal-type rock bits. These were evaluated in specially constructed seal and lubricant test machines. Results indicate the elastomeric seals are capable of 200°C (392°F) service. Three mechanical seal systems were built and evaluated. Three lubricants demonstrated 316°C (600°F) capability. Development is continuing on elastomeric seals, mechanical seals, and lubricants. Detailed descriptions of previous work, and the unique test equipment are presented.

16758 **(SAND—81-0380) Geothermal drilling and completion technology development program plan.** Varnado, S.G.; Kelsey, J.R.; Wesenberg, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76D00789. 94p. NTIS, PC A05/MF A01.

A long-range plan for the development of new technology that will reduce the cost of drilling and completing geothermal wells is presented. The role of this program in relation to the total Federal Geothermal Energy Program is defined and specific program goals are identified. Then, the current status of the program, initiated in FY 1978, is presented, and research and development activities planned through 1987 are described. Budget and milestone estimates for each task are provided. The management plan for implementing the program is also discussed. The goals of this program are to develop the technology required to reduce the cost of drilling and completing geothermal wells by 25% in the near term and by 50% in the long term. Efforts under this program to date have resulted in new roller bit designs that will reduce well costs by 2% to 4%, new drag bits that have demonstrated marked increases in penetration rate, and the field verification of the effectiveness of inert drilling fluids in reducing drill pipe corrosion. Activities planned for the next six years for achieving the program goals are described. Technical activities include work in the areas of drilling hardware, drilling fluids, lost circulation control methods, completion technology, advanced drilling systems, and supporting technology.

1510 Direct Energy Utilization

16759 **Boise geothermal district heating, 1892-1982. Part I. Institutional planning.** Hanson, P.J. pp 17, Section 8, Part I of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Use of geothermal hot water for district space heating, recreation, and domestic purpose began in Boise, Idaho in 1890. The wells and pipeline system established ninety years ago for these purposes is still in use. The system serves approximately 250 residences. The system has gone through a number of historical changes, the most recent receiving its impetus from the energy shortage that began in 1973. This most recent change is the development of a joint partnership between Boise Warm Springs Water District (the old system), and Boise City to improve and expand the old system and develope a new space heating system to serve Boise central business district. The system is planned for completion in 1983, will serve about 500 households, have 2 million feet of office and retail space in 8 buildings, and cost an estimated $8 million. This project, financed with local and DOE funds, is described in terms of institutional and technical considerations.

16760 Boise geothermal heating, 1892-1982. Part II. Technical planning. Little, N.H.; Bissell, R.R. (CH2M Hill, Inc., Boise, ID). pp 27, Section 8, Part II of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Two 10-MW geothermal district heating systems are being developed by Boise City and the Boise Warm Springs Water District (BWSWD) for Boise, Idaho. These systems will provide 170°F (348°K) geothermal water for space heating in downtown Boise and eastern Boise, respectively. The major technical aspects of the preliminary design for the Boise City geothermal district heating system are summarized. In general, the discussion also applies to the BWSWD system.

16761 Feasibility of a geothermal district heating scheme. Lorentz, J.J.; Mountfort, M.V. Auckerland, NZ; New Zealand Energy Research and Development Committee (1980). 47p. (NZERDC—55). NTIS (US Sales Only), PC A03/MF A01.

The present development and exploitation of geothermal energy use in Rotorua and Taupo are reviewed with reference to the future development of a Geothermal District Heating (GDH) scheme. Other aspects which affect the future viability of a GDH scheme and would form the basis for Stage II of this study include: heat load densities (MW/km^2) for the Rotorua City area and the Taupo Borough area, energy usage patterns in Rotorua and Taupo, and household energy consumption in Rotorua and Taupo. In addition, the results of three market surveys are summarized: of non-geothermal users in residential areas of Rotorua and Taupo, of geothermal users in residential areas of Rotorua, and of non-geothermal users in industrial and commercial areas of Rotorua and Taupo. The conclusions drawn from the market surveys have been used to formulate recommendations for the future investigations, and to prepare the terms of reference for a further study project.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 16740

16762 (DOE/ID/12079—23) Summary of potassium/argon age dating, 1980. Evans, S.H. Jr.; Brown, F.H. (Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics). Nov 1980. Contract AC07-79ID12079. 27p. NTIS, PC A03/MF A01.

A significant improvement in efficiency of the K-Ar laboratory was brought about by completion of a second extraction line. Two extractions can now be done routinely each day and the ^{38}Ar spike ratios of the new table will permit dating of much younger samples than previously. Extensive K-Ar dating of samples from the Mineral Mountains shows intervals of silicic volcanism at 0.5, 0.8 and 7.5 m.y. K-Ar dating of plutonic units does not present a consistent picture, however. Plutonic events 35 to 40 m.y., 29 m.y. and 19 to 21 m.y. ago are suggested but interpretation must be considered preliminary. Joint programs with the US Geological Survey now underway to study the Rb-Sr and U-Pb systematics of the Mineral Mountains pluton should aid in unravelling its history. Dating of basalts from the Cove Creek Domes/Twin Peaks area, Utah, has aided in delineating the timing of basaltic volcanism. This adds to the already extensive data on the chronology of volcanic activity in the area. Dating of samples from the Beowawe Known Geothermal Resources Area, Nevada have confirmed earlier dates indicating major volcanism took place 38 m.y. ago and 17 to 16 m.y. ago.

16763 (LBL—12356) Thermodynamics of geothermal fluids. Rogers, P.S.Z. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 253p. NTIS, PC A12/MF A01.

Thesis.

A model to predict the thermodynamic properties of geothermal brines, based on a minimum amount of experimental data on a few key systems, is tested. Volumetric properties of aqueous sodium chloride, taken from the literature, are represented by a parametric equation over the range 0 to 300°C and 1 bar to 1 kbar. Density measurements at 20 bar needed to complete the volumetric description also are presented. The pressure dependence of activity and thermal properties, derived from the volumetric equation, can be used to complete an equation of state for sodium chloride solutions. A flow calorimeter, used to obtain heat capacity data at high temperatures and pressures, is described. Heat capacity measurements, from 30 to 200°C and 1 bar to 200 bar, are used to derive values for the activity coefficient and other thermodynamic properties of sodium sulfate solutions as a function of temperature. Literature data on the solubility of gypsum in mixed electrolyte solutions have been used to evaluate model parameters for calculating gypsum solubility in seawater and natural brines. Predictions of strontium and barium sulfate solubility in seawater also are given.

17 WIND ENERGY

REFER ALSO TO CITATION(S) 16939

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 16772

16764 (DOE/BP/01310—T1) Network wind power over the Pacific Northwest. Progress report, October 1978-September 1979. Hewson, E.W.; Baker, R.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Oct 1979. Contract AC80-78BP01310. 141p. NTIS, PC A07/MF A01.

In 1975 the Bonneville Power Administration (BPA) contracted with Oregon State University (OSU) to perform a feasibility study of the wind power potential in a portion of the Columbia River Gorge. Since that initial assessment the research at OSU has expanded to investigate the wind power potential in the rest of the BPA service area which covers Washington, Oregon, Idaho, western Montana, and northern Nevada. Previous BPA Reports 76-1, 77-2, and 78-3 have documented the progress of this research. The objectives and conclusions of the research during FY 79 are summarized. The data analyzed were for the period June 1978 through May 1979. The details of the research are contained in the report.

16765 (DOE/BP/01310—T1(App.1)) Network wind power over the Pacific Northwest. Appendix I. Wind power site survey report. Hewson, E.W.; Baker, R.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Oct 1979. Contract AC80-78BP01310. 102p. NTIS, PC A06/MF A01.

Results are presented for wind survey field trips to Northwest Washington, Southern Oregon Coast, Central Columbia River Gorge, Columbia Hills, Goodnoe Hills, and Horse Heaven Hills.

16766 (DOE/BP/01310—T1(App.2)) Network wind power over the Pacific Northwest. Wind statistics summaries for the wind power data stations. Hewson, E.W.; Baker, R.W. (Bonneville Power Administration, Portland, OR (USA)). Oct 1979. Contract AC80-78BP01310. 79p. NTIS, PC A05/MF A01.

Data are presented from wind monitoring stations located in Washington and Oregon.

16767 (PNL—3195-WERA-2) Wind energy resource atlas. Volume 2. The North Central Region. Freeman, D.L.; Hadley, D.L.; Elliott, D.L.; Barchet, W.R.; George, R.L. (ERT/Western Scientific Services, Inc., Fort Collins, CO (USA)). Feb 1981. Contract AC06-76RL01830. 191p. NTIS, PC A09/MF A01.

The North Central atlas assimilates six collections of wind resource data: one for the region and one for each of the five states that compose the North Central region (Iowa, Minnesota, Nebraska, North Dakota, and South Dakota). At the state level, features of the climate, topography and wind resource are discussed in greater detail than is provided in the regional discussion, and that data locations on which the assessment is based are mapped. Variations, over several time scales, in the wind resource at selected sta-

tions in each state are shown on graphs of monthly average and international wind speed and power, and hourly average wind speed for each season. Other graphs present speed direction and duration frequencies of the wind at these locations.

16768 **(PNL—3195-WERA-3) Wind energy resource atlas. Volume 3. Great Lakes Region.** Paton, D.L.; Bass, A.; Smith, D.G.; Elliott, D.L.; Barchet, W.R.; George, R.L. (Environmental Research and Technology, Inc., Concord, MA (USA)). Feb 1981. Contract AC06-76RL01830. 187p. NTIS, PC A09/MF A01.

The Great Lakes Region atlas assimilates six collections of wind resource data, one for the region and one for each of the five states that compose the Great Lakes region: Illinois, Indiana, Michigan, Ohio, Wisconsin. At the state level, features of the climate, topography, and wind resource are discussed in greater detail than in the regional discussion and the data locations on which the assessment is based are mapped. Variations over several time scales in the wind resource at selected stations in each state are shown on graphs of monthly average and interannual wind speed and power, and of hourly average wind speed for each season. Other graphs present speed, direction, and duration frequencies of the wind at these locations.

16769 **(PNL—3195-WERA-10) Wind energy resource atlas. Volume 10. Alaska region.** Wise, J.L.; Wentink, T. Jr.; Becker, R. Jr.; Comiskey, A.L.; Elliott, D.L.; Barchet, W.R.; George, R.L. (Alaska Univ., Anchorage (USA). Arctic Environmental Information and Data Center). Dec 1980. Contract AC06-76RL01830. 181p. NTIS, PC A09/MF A01.

This atlas of the wind energy resource is composed of introductory and background information, a regional summary of the wind resource, and assessments of the wind resource in each subregion of Alaska. Background is presented on how the wind resource is assessed and on how the results of the assessment should be interpreted. A description of the wind resource on a state scale is given. The results of the wind energy assessments for each subregion are assembled into an overview and summary of the various features of the Alaska wind energy resource. An outline to the descriptions of the wind resource given for each subregion is included. Assessments for individual subregions are presented as separate chapters. The subregion wind energy resources are described in greater detail than is the Alaska wind energy resource, and features of selected stations are discussed. This preface outlines the use and interpretation of the information found in the subregion chapters.

1704 Economics

REFER ALSO TO CITATION(S) 16776, 16777, 16779

16770 **(DOE/SEA—1109-20401/81/1) Economic analysis of wind-powered refrigeration cooling/water-heating systems in food processing. Final report.** Garling, W.S.; Harper, M.R.; Merchant-Geuder, L.; Welch, M. (Tetra Tech, Inc., Arlington, VA (USA)). Mar 1980. Contract AI01-76ET20319. 150p. NTIS, PC A07/MF A01.

Potential applications of wind energy include not only large central turbines that can be utilized by utilities, but also dispersed systems for farms and other applications. The US Departments of Energy (DOE) and Agriculture (USDA) currently are establishing the feasibility of wind energy use in applications where the energy can be used as available, or stored in a simple form. These applications include production of hot water for rural sanitation, heating and cooling of rural structures and products, drying agricultural products, and irrigation. This study, funded by USDA, analyzed the economic feasibility of wind power in refrigeration cooling and water heating systems in food processing plants. Types of plants included were meat and poultry, dairy, fruit and vegetable, and aquaculture.

16771 **(P—500-81-014) Guide to financial assistance for wind energy.** Hirsch, E.; Brierly, L.; Schwent, V. (California Energy Commission, Sacramento (USA)). Mar 1981. 48p. California Energy Commission, Sacramento, CA.

This guide is designed to provide information about state and federal financial assistance programs currently available for wind energy development in California. A general description of each program is included, as well as eligibility requirements and restrictions placed on distribution of funds. In addition, contacts are listed for those wishing more information on wind energy programs.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 16765, 16766, 16767, 16770

16772 **(DOE/ET/20283—2) Application of statistical techniques to wind characteristics at potential wind energy-conversion sites. Final report, October 1, 1978-September 30, 1979.** Corotis, R.B. (Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering). May 1980. Contract AS06-76ET20283. 172p. NTIS, PC A08/MF A01.

The distribution for the magnitude of the vector sum of two orthogonal horizontal wind velocity components is often modelled by the Rayleigh, which is derived assuming that the components are independent, identically distributed, zero-mean, Gaussian random variables; the probability density function for a more realistic case where the two components are correlated and not equal in variance is derived. It is found that the derived distribution is adequately modelled by the Rayleigh distribution. A 24-hour record of 20-second average wind speed was collected to assess the effect of sampling rate and averaging time on computed wind speed means and variances, autocorrelation, and run duration. Definite effects on autocorrelation and run duration due to averaging time and sampling rate, respectively, are observed. An approximate procedure is developed to simulate the time sequence of wind speed at a single site; the procedure uses a Weibull distribution with conditional parameters updated each hour as a function of the previously simulated value and the autocorrelation.

16773 **(DOE/ET/20283—3) Handbook for the application of statistical techniques to wind characteristics at potential wind-energy-conversion sites. Final report, October 1, 1978-September 30, 1979.** Corotis, R.B. (Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering). May 1980. Contract AS06-76ET20283. 29p. NTIS, PC A03/MF A01.

Procedures are presented for the use of statistical techniques to analyze wind data collected at candidate sites for wind turbine installations. Effective utilization of data in determining the wind regime is important in gaining the most reliable information necessary to assess turbine performance and generated power in a relatively short period of on-site collection. This handbook specifically discusses adjustment procedures and reliability measures for the mean wind speed at a site; selection of a probability distribution for the hourly wind speed and calibration from observed data; employment of a probability model for wind speed persistence; and simplified techniques for the time series simulation of hourly wind speed at a site and array power from a region. A brief discussion of the limitations implicit in National Weather Service data is also included.

16774 **(DOE/R5/10124—T1) Windmill for irrigation pond. Final report.** Klaus, T.J. (Klaus (Thomas), Cooks, MI (USA)). 9 Sep 1980. Contract FG02-79R510124. 9p. NTIS, PC A02/MF A01.

Portions of document are illegible.

The application of a wind-powered pump for irrigating a strawberry farm is described.

16775 **(DOE/R5/10134—1) Using a wind electric system to generate power into a utility grid: a project in south central rural Minnesota.** Griffin, T.; Tate, M. (Natural Resources Corp., Brooklyn Park, MN (USA)). 1981. Contract FG02-79R510134. 22p. NTIS, PC A02/MF A01.

Design specifications are presented for newly designed Jacobs 10 KVA wind turbine system.

16776 **(DOE/SEA—1109-20401/81/2) Economic analysis of wind-powered crop drying. Final report.** Garling, W.S.; Harper, M.R.; Merchant-Geuder, L.; Welch, M. (Tetra Tech, Inc., Arlington, VA (USA)). Mar 1980. Contract AI01-76ET20319. 121p. NTIS, PC A06/MF A01.

Potential applications of wind energy include not only large central turbines that can be utilized by utilities, but also dispersed systems for farms and other applications. The US Departments of Energy (DOE) and Agriculture (USDA) currently are establishing the feasibility of wind energy use in applications where the energy can be used as available, or stored in a simple form. These applications include production of hot water for rural sanitation, heating and cooling of rural structures and products, drying agricultural products, and irrigation. This study, funded by USDA, analyzed the economic feasibility of wind power in crop drying. Drying of corn, soybeans, rice, peanuts, tobacco, and dehydrated alfalfa were addressed.

16777 **(DOE/SEA—7315-2074/81/2) Economics of wind energy for irrigation pumping.** Lansford, R.R.; Supalla, R.J.; Gilley, J.R.; Martin, D.L. (Southwest Research and Development Co., Las Cruces, NM (USA)). 14 Jul 1980. Contract AI01-76ET20319. 89p. NTIS, PC A05/MF A01.

This study addresses some of the economic questions associated with wind power as an energy source for irrigation under different situations in seven regions of the nation. The analysis will provide the United States Departments of Energy and Agriculture with target investment costs for wind turbines used for irrigation pumping; it also will provide policy makers with bases for adjusting taxes to make alternative sources of energy investments more attractive. Three types of wind systems were considered for each of the seven regions. The three types of wind powered irrigation systems evaluated for each region were: wind assist combustion engines (diesel, natural gas, propane pane), wind assist electric engines, with or without sale of surplus electricity, and stand alone reservoir systems with gravity flow reservoirs.

16778 **(DOE/SEA—7315-20741/81/1) On-farm US irrigation pumping plants. Final report.** Gilley, J.R. (Colorado School of Mines, Golden (USA). Dept. of Geophysics). Mar 1981. Contract AI01-76ET20319. 60p. NTIS, PC A04/MF A01.

Over 473,000 on-farm pumping plants are being used to pump and deliver irrigation water in the United States. The distribution of these units by geographic regions and potential wind power zones was determined. Over 60 percent of the pumping units in the US are smaller than 37.3 kW (50 horsepower) in size and only 9.4 percent of the units are larger than 74.6 kW in size (100 horsepower). Over 49 percent of these pumps (231,440) are located in the six Great Plains States of Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Texas. This area also has the largest potential wind power in the US during the primary irrigation season. Over 51 percent of the pumping units are located in wind zones having a potential average wind power greater than 250 W/m^2 at an elevation of 50 meters. However, only 6.5 percent of the units are located in the largest potential average wind power zone (> 400 W/m^2 at 50 meters). In general, those areas which have greater potential wind power, have larger sized pumping units.

16779 **(DOE/SF/01963—T2) Community wind electrical power case study: Muir Beach. Final report.** Bluhm, R.; Freebairn-Smith, R. (Freebairn-Smith (Rod), Muir Beach, CA (USA)). Oct 1979. Contract FG03-78SF01963. 52p. NTIS, PC A04/MF A01.

Muir Beach experiences relatively steady northwest coastal winds. Recordings at anemometer stations have indicated wind speeds averaging 10 to 12 mph over the year. This compares favorably with the minimum of 8 to 9 mph generally considered necessary for feasible wind-electric generation. Given the town's wind environment, a 100 kW wind turbine of the kind planned could provide an annual output of about 150,000 kWh, or about one-eighth of Muir Beach's projected need. Especially promising for Muir Beach are other potential sites at higher elevations on neighboring Mt. Tamalpais, where federal records indicate annual average speeds of 18 mph. Each 100 kW wind turbine sited there could conservatively yield at least double and perhaps triple the output of the first system.

16780 **(PNL—3703) Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979.** Sandusky, W.F.; Renne, D.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1981. Contract AC06-76RL01830. 151p. NTIS, PC A08/MF A01.

Summarized hourly meteorological data for fifteen candidate and wind turbine generator sites are presented in this report. These data are collected for the Department of Energy for the purpose of evaluating the wind energy potential at these sites and are used to assist in selection of potential sites for installation and testing of large wind turbines in electric utility systems. For each site, data are given in eight tables and one figure. Use of information from these tables, with information about specific wind turbines, should allow the user to estimate the potential for wind energy production at each site.

16781 **(SAND—80-2646) Vertical-axis wind-turbine drive-train transient dynamics.** Clauss, D.B.; Carne, T.G. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01.

Start-up of a vertical-axis wind-turbine causes transient torque oscillations in the drivek-train with peak torques which may be over two and one-half times the rated torque of the turbine. These peak torques are of sufficient magnitude to possibly damage the drive train; safe and reliable operation requires that mechanical components be overdesigned to carry the peak torques caused by transient events. A computer code, based on a lumped parameter model of the drive train, has been developed and tested for the Low Cost 17-Meter turbine; the results show excellent agreement with field data. The code has subsequently been used to predict the effect of a slip clutch on transient torque oscillations. It has been demonstrated that a slip clutch located between the motor and brake can reduce peak torques by thirty-eight percent.

16782 **(SAND—80-2669C) Guy cable design and damping for vertical axis wind turbines.** Carne, T.G. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 9p. (CONF-810226—3). NTIS, PC A02/MF A01.

From 2. DOE/NASA wind turbine dynamics workshop; Cleveland, OH, USA (24 Feb 1981).

Guy cables are frequently used to support vertical axis wind turbines since guying the turbine reduces some of the structural requirements on the tower. The guys must be designed to provide both the required strength and the required stiffness at the top of the turbine. The axial load which the guys apply to the tower, bearings, and foundations is an undesirable consequence of using guys to support the turbine. Limiting the axial load so that it does not significantly affect the cost of the turbine is an important objective of the cable design. The lateral vibrations of the cables is another feature of the cable design which needs to be considered. These aspects of the cable design are discussed in this paper, and a technique for damping cable vibrations is mathematically analyzed and demonstrated with experimental data.

16783 **Induction machine.** Owen, W.H. (to Department of Energy). US Patent 4,228,391. 14 Oct 1980. Filed date 14 Apr 1978. vp.

PAT-APPL-896539.

A polyphase rotary induction machine for use as a motor or generator utilizes, a single rotor assembly having two series connected sets of rotor windings, a first stator winding disposed around the first rotor winding and means for controlling the current induced in one set of the rotor windings compared to the current induced in the other set of the rotor windings. The rotor windings may be wound rotor windings or squirrel cage windings.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 16373, 16374, 16447, 16620, 16621, 16623, 16624, 16625, 16626, 16800, 16913, 16926, 16927, 16936, 17046, 17047, 17233, 17241

16784 (DOE/ET/15208—T1(Vol.1)) Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-hp range. Phase I final report. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Oct 1980. Contract W-31-109-ENG-38;AC02-79ET15208. 44p. NTIS, PC A03/MF A01.

The first phase of the design and development of Stirling engines for stationary power generation applications in the 373 kW (500 hp) to 2237 kW (3000 hp) range was completed. The tasks in Phase I include conceptual designs of large Stirling cycle stationary engines and program plan for implementing Phases II through V. Four different heater head designs and five different machine designs were prepared in sufficient detail to select a design recommended for development in the near future. A second order analysis was developed for examining the various loss mechanisms in the Stirling engine and for predicting the thermodynamic performance of these engines. The predicted engine thermal brake efficiency excluding combustion efficiency is approximately 42% which exceeds the design objective of 40%. The combustion system designs were prepared for both a clean fuel combustion system and a two-stage atmospheric fluidized bed combustion system. The calculated combustion efficiency of the former is 90% and of the latter is 80%. Heat transport systems, i.e., a heat exchanger for the clean fuel combustion system and a sodium heat pipe system for coal and other nonclean fuel combustion systems were selected. The cost analysis showed that for clean fuels combustion the proposed 2237 kW (3000 hp) system production cost is $478,242 or $214/kW ($159/hp) which is approximately 1.86 times the cost of a comparable size diesel engine. For solid coal combustion the proposed 2237 kW (3000 hp) system production cost is approximately $2,246,242 which corresponds to a cost to power capacity ratio of $1004/kW ($749/hp). The two-stage atmospheric fluidized bed combustion system represents 81% of the total cost; the engine represents 14% depending on the future price differential between coal and conventional clean fuels, a short payback period of the proposed Stirling cycle engine/FBC system may justify the initial cost. (LCL)

16785 (DOE/ET/15208—T1(Vol.2)) Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-horsepower range. Phase I final report. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Oct 1980. Contract W-31-109-ENG-38;AC02-79ET15208. 226p. NTIS, PC A11/MF A01.

A program plan and schedule for the implementation of the proposed conceptual designs through the remaining four phases of the overall large Stirling engine development program was prepared. The objective of Phase II is to prepare more detailed designs of the conceptual designs prepared in Phase I. At the conclusion of Phase II, a state-of-the-art design will be selected from the candidate designs developed in Phase I for development. The objective of Phase III is to prepare manufacturing drawings of the candidate engine design. Also, detailed manufacturing drawings of both 373 kW (500 hp) and 746 kW (1000 hp) power pack skid systems will be completed. The power pack skid systems will include the generator, supporting skid, controls, and other supporting auxiliary subsystems. The Stirling cycle engine system (combustion system, Stirling engine, and heat transport system) will be mounted in the power pack skid system. The objective of Phase IV is to procure parts for prototype engines and two power pack skid systems and to assemble Engines No. 1 and 2. The objective of Phase V is to perform extensive laboratory and demonstration testing of the Stirling engines and power pack skid systems, to determine the system performance and cost and commercialization strategy. Scheduled over a 6 yr period the cost of phases II through V is estimated at $22,063,000. (LCL)

16786 (EPRI-AP—1681(Vol.1)) High-reliability gas turbine combined-cycle development program: Phase I. Final report. Kunkel, R.G. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Jan 1981. 359p. NTIS, PC A16/MF A01.

The objective of the High Reliability Gas Turbine Combined Cycle Development Program is to generate a new conceptual centerline design for gas turbine and accessories, with reliability as the key parameter. Tradeoff studies of reliability vs cost, performance, firing temperature and other parameters formed the basis for all major design approaches and decisions. This program results in the conceptual design of a gas turbine combined-cycle plant with (a) high reliability and performance to warrant consideration for baseload service, (b) fuels flexibility for distillate and residual fuels, (c) turbine emissions which meet the more stringent New Source Performance Standards, (d) identified conversion requirements for coal-derived fuels and peaking/mid-range duty cycles, and (e) identified list of potential present product retrofits. This conceptual combined-cycle design is planned, by EPRI, to be a commercial offering by the mid 80's. As such, it is a near-term machine configuration with state-of-the-art engineering. This final report of Phase I of RP1187, High-Reliability Gas Turbine Combined-Cycle Development, presents the results of a study conducted to determine the potential reliability of a combined-cycle plant using a new centerline design approach with the main design parameter being reliability rather than performance. The new gas turbine for this program was conceptually developed around the 1985°F (1085°C) firing temperature cycle. The total plant was developed using maintainability, serviceability, and the potential need for conversion to coal-derived fuels and other duty cycles. The controls and accessories were found to provide cost effective changes and modifications.

16787 (EPRI-EL—1424(Vol.2)) Determination of synchronous-machine-stability study constants. Final report. Coultes, M.E.; Dandeno, P.L.; Kundur, P.; Poray, A.T.; Watson, W.; Zein El-Din, H.M. (Ontario Hydro, Toronto (Canada)). Dec 1980. 508p. NTIS, PC A22/MF A01.

Data for two different 500 MW turbogenerators was gathered from standstill, on-line, and rated-speed open-circuit frequency response, dc inductance, 60 Hz field impedance, and line switching tests. The relative merits of generator models computed from standstill and on-line frequency response tests, stator decrement tests and sudden short circuit tests were judged by their ability to reproduce the measured line switching transients. From the results, an equivalent circuit model with three rotor windings in each axis and d-axis rotor circuit mutual leakage elements is recommended, with the parameters of the model being obtained from standstill, and in some cases also on-line frequency response measurements. Magnetic nonlinearity of the iron was significant in all parts of the work. Q-axis saturation could not be estimated adequately from d-axis characteristics. Steady state measurements, on load, were used to compute the q-axis saturation curve.

16788 (EPRI-EM—1717) Development of zinc-bromine batteries for utility energy storage. Interim report, September 1978-August 1979. Putt, R.A. (Gould, Inc., Rolling Meadows, IL (USA). Gould Labs.). Mar 1981. 149p. NTIS, PC A07/MF A01.

The goals in the first year of study were to build and test full-size zinc-bromide cell hardware in the form of three 8-kWh submodules and to provide a cost-design study of an 80-kWh module. Supporting studies were included for developing the basic electrochemistry of the system. The program was based on technology developed during a prior contract in which the system's design simplicity, high efficiency, long cycle life, and ease of scale-up, all of which are requirements of a battery for utility application were demonstrated. The system design which evolved during that program comprised a monopolar cell stack using titanium electrodes and a microporous separator, circulation of electrolyte through both the negative and positive sides of the cell stack, and storage of electrolyte and bromine (the latter in the form of a liquid polybromide complex) externally to the cell stack. Two monopolar, 8-kWh submodules of that design were built during the present program. Despite poor electrochemical efficiencies, one of the submodules achieved over 160 deep discharge cycles in continuous hands-off automatic cycling, indicating the inherent cyclability of the system. A major design improvement was made during the program, which has proved crucial to the successful scale-up of the zinc-bromine battery - conversion from a monopolar to a bipolar cell design. The bipolar design has been shown to be superior with respect to cost, performance, and simplicity. Conversion from the monopolar to bipolar cell design was achieved at the 8-kWh submodule level with a minimal perturbation on the hardware construction and testing schedule; one bipolar submodule was built and under test within the

12-month contract period. The 80-kWh stand-alone module will comprise 10 identical 8-kWh submodules of the bipolar electrode configuration, electrolyte circulation systems (pumps, tanks, and plumbing) for both the negative and positive electrolytes, and a bromine storage system.

16789 **(PB—80-212764) Optimum mechanical draft wet cooling towers to supplement once-through cooling at selected Missouri River sites.** Giaquinta, A.R.; Croley, T.E. II. (Iowa Univ., Iowa City (USA). Inst. of Hydraulic Research). Oct 1979. Contract DI-14-34-0001-8017. 47p. NTIS, PC A03/MF A01.

A complete, detailed analysis of wet tower/once-through hybrid cooling systems was carried out to give the most economical system arrangements and the optimum tower size for power plants on the Missouri River. To establish the design, performance, and cost of the optimum cooling system, a computer program was developed which gave the thermodynamic and economic performances of hybrid cooling systems. The objective was to maximize the permissible river heat assimilation capacity using different hybrid cooling system arrangements.

16790 **(PB—80-222631) Analysis of construction conditions affecting the structural response of the cooling tower at Willow Island, West Virginia.** Lew, H.S.; Fattal, S.G. (National Engineering Lab. (NBS), Washington, DC (USA)). Jul 1980. 49p. NTIS, PC A03/MF A01.

The initial investigation of the Willow Island cooling tower collapse (NBSIR 78-1578) established that the most probable cause of the collapse was the imposition of construction loads on the tower before the concrete had gained adequate strength. The analysis presented herein responds to questions outside the scope of that investigation which considered only actual conditions existing at the time of the collapse. The present investigation shows that failure would initiate in lift 28 if the concrete strength in that lift is 100 psi (6.9 MPa) or less, and to maintain a safety factor of 2.0, the concrete strength in that lift should be 4000 psi (27.6 MPa). This study also reveals that even if an additional bolt had been introduced between each exterior jumpform beam and the tower, the stresses would not have been relieved enough to prevent failure of lift 28. Finally, it is shown, that if the ground anchor point of the static line had been kept at the location occupied just prior to its last move to a location near the center of the tower, the stresses in the shell due to construction loads would have been relieved to the extent that failure of lift 28 would probably not have occurred.

16791 **Means and method for the destruction of particles entrained in a gas stream.** Botts, T.E.; Powell, J.R. (to Department of Energy). US Patent 4,226,369. 7 Oct 1980. Filed date 17 Aug 1978. vp.

PAT-APPL-934552.

An apparatus and method for the destruction of particles entrained in a gas stream are disclosed. Destruction in the context of the subject invention means the fragmentation and/or vaporization of particles above a certain size limit. The subject invention contemplates destroying such particles by exposing them to intense bursts of laser light, such light having a frequency approximately equal to or less than the mean size of such particles. This invention is particularly adopted to the protection of turbine blades in open cycle coal-fired turbine systems. Means for introducing various chemical species and activating them by exposure to laser light are also disclosed.

16792 **Water quality control at Detroit Edison Central Heating.** Les, J.G. (Detroit Edison Co., MI). pp 11, Section 25 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

The Detroit Edison Central Heating System has a total capacity of approximately 3 million lb/h of steam produced at 3 plants. The makeup water comes from the City of Detroit. The steam produced meets FDA standards for food usage and sterilization. The water quality control procedures used in this system to assure proper maintenance of equipment and output steam characteristics are explained from the sampling procedures through the corrective measures taken. The effects of phosphate, caustic, sulfuric acid and sodium sulfite additions on the corrosion, erosion and plugging of power plant equipment, and the control of feedwater acidity, hardness, oxygen content and electric conductivity are discussed. A marked improvement in the water quality at the heating plant has been achieved, which in turn results in improved plant operation. (LCL)

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 16403, 16405, 16406, 16635, 16636, 17352, 17451, 17524

16793 **(DOE/GFETC/10059—2) Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980.** Burkhardt, F.R.; Persnger, M.M. (Virginia Corp. of Richmond (USA)). 1980. Contract AC18-79FC10059. 145p. NTIS, PC A07/MF A01.

Problems with convection ash fouling and wall slagging were considerable during our study. The Dakota lignites posed the greatest problems, particularly with fouling. The subbituminous coals had considerable problems, related mostly with wall slagging. The Texas lignites had few problems, and those were only associated with wall slagging. The generation losses were as follows: The Dakota lignite burning stations averaged an overall availability of 87.13%. Convection fouling outages were responsible for 57.75% of this outage time for a decrease in availability of 7.43%. Fouling was responsible for curtailment losses of 317,649 Mwh or 8.25% of the remaining available generation. Slagging was responsible for losses of 2732 megawatt hours or .07% of the remaining available generation. Total ash related losses amounted to 16.08% of the total available generation. The subbituminous burning stations averaged an overall availability of 78.36%. Total ash related losses amounted to 1.54% of the total available generation. The Texas lignite burning stations averaged an overall availability of 80.63%. No ash related outage losses occurred. Slagging curtailments accounted 0.08% of the total available generation. Costs due to ash fouling and slagging related curtailments are a tremendous sum. Seven power stations were studied for a six month period to assess costs. The total cost directly attributable to ash slagging and fouling condition was $20,638,113. Recommendations for reducing the problems involve soot blowers, control of furnace gas exit temperature, water blowers and more conservative boiler design.

16794 **(EPRI-CS—1677) Economics of four FGD systems. Final report.** Augustine, F.; Severson, S.D.; Winter, J.L. (Stearns-Roger Engineering Co., Denver, CO (USA)). Jan 1981. 208p. NTIS, PC A10/MF A01.

The Electric Power Research Institute contracted with Stearns-Roger Engineering Corporation to prepare an assessment of the economics of four flue gas desulfurization (FGD) systems: a conventional limestone scrubber, a cocurrent limestone scrubber, a Chiyoda Thoroughbred 121 limestone scrubber, and a Wellman-Lord scrubber. This report presents and compares the economic evaluations of each of these systems. Using the standardized evaluation premises, Stearns-Roger developed typical FGD systems for each of the four selected processes designed to meet the latest Federal New Source Performance Standards (NSPS) promulgated June 11, 1979. EPRI's Economic Premises for Electric Power Generating Systems were used as the basis for the economic criteria. Technical and cost data were developed for the treatment of flue gases from large-scale utility boilers (500 MW) burning typical high sulfur coal (4%). These data were then evaluated to test cost sensitivities to changes in coal sulfur content and plant size.

16795 **(EPRI-CS—1736(Vol.1)) Construction materials for wet scrubbers. Final report.** Rosenberg, H.S.; Krause, H.H.; Nowacki, L.J.; Kistler, C.W.; Beavers, J.A.; Engdahl, R.B.; Dick, R.J.; Oxley, J.H. (Battelle Columbus Labs., OH (USA)). Mar 1981. 155p. NTIS, PC A08/MF A01.

This report is a comprehensive documentation and analysis of utility experience with materials of construction in full-scale lime/limestone wet FGD systems on boilers burning eastern or western coals. Information was collected for the following FGD

system components; prescrubbers, absorbers, spray nozzles, mist eliminators, reheaters, fans, ducts, expansion joints, dampers, stacks, storage silos, ball mills and slakers, pumps, piping and valves, tanks and thickeners, agitators and rakes, vacuum filters and centrifuges, and pond linings. Materials documentation and analysis includes successes, failures, reasons for success or failure, failure mechanisms, and relative costs of various materials. The results are designed to be a first step in aiding utilities and FGD equipment suppliers in selecting materials that will perform satisfactorily without unnecessary expense. Outlet ducts downstream from the outlet dampers and stack linings have a significant history of materials problems and are critical components in that failure may require complete boiler shutdown and loss of generating capacity for lengthy periods. Prescrubbers, absorbers, reheaters, outlet ducts upstream of the outlet dampers, dampers, pumps, and piping and valves have a moderate history of materials problems but failures may not require complete boiler shutdown. Spray nozzles, mist eliminators, fans, inlet and bypass ducts, expansion joints, storage silos, ball mills and slakers, tanks and thickeners, agitators and rakes, vacuum filters and centrifuges, and pond linings have a relatively low history of materials problems and/or are amenable to rapid repair or replacement.

16796 **(PB—80-211832) EPA utility FGD survey: January-March 1980. Quarterly report.** Smith, M.; Melia, M.; Gregory, N. (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). May 1980. Contract EPA-68-01-4147. 262p. NTIS, PC A12/MF A01.

The report is the first of three supplements updating the October-December 1979 report (EPA-600/7-80-029a) and should be used in conjunction with it. The report, generated by a computerized data base system, presents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems, operational domestic particle scrubbers, and Japanese coal-fired utility boiler FGD installations. It summarizes information contributed by the utility industry, process suppliers, regulatory agencies, and consulting engineering firms. Domestic FGD systems are tabulated alphabetically by development status (operational, under construction, or in planning stages), utility company, process supplier, process, and waste disposal practice. It presents data on boiler design, FGD system design, fuel characteristics, and actual performance. It includes unit by unit dependability parameters and discusses problems and solutions associated with the boilers and FGD systems. Process flow diagrams and FGD system economic data are appended.

16797 **(PB—80-213036) Review of new source performance standards for coal-fired utility boilers, phase three report, sensitivity studies for the selection of a revised standard. Final report.** Van Horn, A.J.; Ferrell, G.C.; Brandi, R.M.; Chapma, R.A. (Teknekron, Inc., Berkeley, CA (USA). Energy and Environmental Engineering Div.). Jun 1979. Contract EPA-68-01-3092. 206p. NTIS, PC A10/MF A01.

This report summarizes a study of the projected effects of several potential revisions to the current New Source Performance Standards (NSPS) for sulfur dioxide (SO_2) emissions from coal-fired electric utility boilers. The revised NSPS (RNSPS) is assumed to apply to all coal-fired units with a generating capacity of 25 megawatts or more, beginning operation after 1982. A principal purpose of this phase of the RNSPS analysis is to present to decision makers the critical uncertainties that will influence utility costs, coal choices, and pollution control measures adopted by utilities in response to alternative standards.

16798 **(PB—80-219249) Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978.** Ciliberti, D.F.; Ahmed, M.M.; Ulerich, N.H.; Alvin, M.A.; Keairns, D.L. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jan 1980. Contract EPA-68-02-2132. 181p. NTIS, PC A09/MF A01.

The report gives results of an investigation of particulate, NOx, and trace element control for atmospheric and pressurized fluidized-bed combustion (FBC) systems used with coal. A model, developed previously to project the loading and size distribution of particulate emissions from FBC systems, was used to permit an integrated analysis of particle control options for FBC. An experimental 150 scf/sec high-temperature/-pressure particulate control test facility, treating simulated flue gas, was constructed and shaken down to permit investigation of alternative particulate control devices. Available data on NOx emissions from FBC, and on NOx formation and decomposition, are reviewed to identify significant FBC operating parameters affecting NOx emissions, and to assess formation/decomposition mechanisms that may be controlling in FBC. The previous thermodynamic projections of trace element emissions from FBC were expanded to include aluminum, iron, titanium, cobalt, chromium, manganese, molybdenum, and nickel. These projections provide a first-level approximation of the distribution of volatile and condensed phases of compounds of these metals in FBC effluent streams.

16799 **(PB—80-219256) Experimental/engineering support for EPA's FBC program: final report. Volume III. Solid residue study. Final report, January 1977-December 1978.** Sun, C.C.; Peterson, C.H.; Keairns, D.L. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jan 1980. Contract EPA-68-02-2132. 230p. NTIS, PC A11/MF A01.

The report gives results of experimental studies of the leaching properties and thermal activity of solid residues from the fluidized-bed combustion (FBC) of coal. Means for processing the residues, to reduce the environmental impact of their disposal, are also studied. Previous leaching and thermal activity tests were expanded to include residues from additional experimental FBC units, including both atmospheric and pressurized systems. Leaching tests were conducted on both untreated residues and residue samples processed into a cement-like material. Results indicate that the major potential contaminants in the leachate from the FBC residues are the high pH, total dissolved solids, and sulfate levels, all of which are above drinking water regulations. Heat release when initially exposed to water, due to calcium oxide hydration, may also create a handling problem. Trace metals in the leachate do not generally exceed drinking water regulations. Processing of the residues caused some reduction in leachate contaminant levels. Additional tests on processing and utilizing FBC residues are also reported.

16800 **(PB—80-220627) Environmental assessment of a waste-to-energy process: Burlington Electric's wood and oil co-fired boiler.** Golembiewski, M.A. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1980. Contract EPA-68-02-2166. 179p. NTIS, PC A09/MF A01.

The No. 1 boiler at Burlington Electric, which was tested for this study, is fueled by a combination of wood chips and No. 2 fuel oil. Four effluent streams were sampled and analyzed for this assessment program: bottom ash; primary collector ash; secondary collector ash; and stack emissions. Common to all streams were characterizations for elemental composition and potentially hazardous compounds such as polychlorinated biphenyls and polycyclic aromatic hydrocarbons. In addition, the boiler exhaust gases were analyzed for particulate, NOx, SO_2, CO, and total hydrocarbon concentrations.

16801 **(PB—80-220957) Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 1. Technical results. Final report, March 1977-May 1978.** Lim, K.J.; Waterland, L.R.; Castaldini, C.; Chiba, Z.; Higginbotham, E.B. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Apr 1980. Contract EPA-68-02-2160. 434p. NTIS, PC A19/MF A01.

The report gives results of an evaluation of combustion modification techniques for coal-, oil-, and gas-fired utility boilers, with respect to NOx control reduction effectiveness, operational impact, thermal efficiency impact, capital and annualized operating costs, and effect on emissions of pollutants other than NOx. For gas- and oil-fired boilers, 30 to 60% NOx reductions are achievable with the combined use of staged combustion, flue gas recirculation, and low excess air at an annualized operating costs, of $0.50 to $3.00/kW-yr. For retrofit control of existing coal-fired boilers, low NOx burners and/or staged combustion yields a 30 to 60% NOx reduction at an annualized cost of $0.40 to $1.20/kW-yr. For new sources, modified furnace design with low NOx burners and/or

overfire air can achieve emission levels of 260 to 170 ng/J (40 to 60% reduction). Detailed emission tests on a 200 MW coal-fired boiler showed that changes in trace specie emissions due to combustion modifications were small compared to the benefit of reduced NOx emissions.

16802 **NO/sub x/ control and recovery from products of combustion.** Evoniuk, C.J.; McCandless, F.P. (to Dept. of Energy). US Patent Application 161,482. 20 Jun 1980. 14p.

The disclosed method for removing nitric oxide and or nitrogen dioxide (NO/sub x/) from a gaseous stream comprises the step of intimately mixing sodium or potassium carbonate and either ferric oxide or manganese dioxide. The gaseous stream containing NO/sub x/ is subsequently brought into contact with the mixture at a temperature between 300°C and 500°C to cause absorption of the NO/sub x/ in the mixture. Nitric oxide can be desorbed from the mixture by elevating its temperature or by other chemical processes. It is also possible to return the concentrated NO/sub x/ gaseous products to the producing combustion chamber for decomposition at the equilibrium concentration at the combustion chamber temperature. It is a first object of this disclosure to provide an effective solid sorbent for NO/sub x/ in a gaseous stream, the sorbent being produced by simple mixing without requiring further preprocessing of the chemicals before or after their mixture. Another object of this invention is to provide a solid sorbent having higher absorbing capabilities than those previously reported. Another object is to provide a solid sorbent which is effective in gaseous streams containing substantial quantities of either carbon dioxide or oxygen.

16803 **Long-range regional power plant siting model. Proc. Paper 14322.** Meier, P.M. (Brookhaven National Lab., Upton, NY). *Journal of the Energy Division (American Society of Civil Engineers)*; **105**: No. EY1, 117-135(Jan 1979).

The location-theoretical model developed in this paper begins to address a number of current energy planning concerns. Firstly, it provides a link between national/regional energy planning models, on the one hand, and environmental impact models on the other, allowing more useful insights into the environmental consequences of a particular national/regional energy future. Secondly, it gives the policy analyst, at the state and regional level, a powerful tool for analyzing the consequences of particular long-range siting and environmental policy options. Thus, while clearly unsuited as a tool to aid utilities identify specific sites, it can be used effectively by public agencies with regulatory jurisdiction over siting to provide an overall framework for the assessment of a particular siting permit application. To be sure, the linearization of many engineering features of the siting problem, and particularly the linearization of transmission, is a compromise that must be accepted in order to use the unique computational advantages of an LP framework. Not only is even a large LP quite cheap to run using one of the modern commercial codes (~ $10 per run for the New York Power Pool at commercial rates using the CDC APEX code), but the ability to gain additional insights from the analysis of the marginal costs of binding constraints, and other post-optimality analysis features, provide powerful incentives for using LP. If used in conjunction with a load flow transmission analysis, there is every reason to believe that even very detailed issues can be analyzed with sufficient rigor for long-range regional analysis, especially when also coupled to a generation mix optimization program.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 16910, 16928, 16929, 16930, 16931, 16935

16804 **(CONF-810433—1) Generalized model for electric distribution systems.** Robinson, H.J. III; Reddoch, T.W.; Klein, J.W. (Oak Ridge National Lab., TN (USA); Jet Propulsion Lab., Pasadena, CA (USA); Tennessee Univ., Knoxville (USA). Dept. of Electrical Engineering). 1981. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01.

From IEEE region 3 southeastern conference and exhibit; Huntsville, AL, USA (5 Apr 1981).

A generalized mathematical model is constructed of single-phase induction machines employed within a three-phase distribution system. It is shown that this composite model retains single-phase distribution detail and describes the intrinsic characteristics of the single-phase induction generator. Power system fault(s) and circuit breaker response(s) are also modeled. Preliminary results of digital simulation indicate that a small integration step size is required to insure mathematical stability. For this reason, a dqo transformation of the generalized model is investigated and it is concluded that the presence of single-phase induction machines prevents further simplification of the system equations.

16805 **(DOE/ET/29102—1) Research on stochastic power-flow study methods. Final report.** Heydt, G.T. (ed.). (Purdue Univ., Lafayette, IN (USA)). Jan 1981. Contract AS02-77ET29102. 855p. NTIS, PC A99/MF A01.

A general algorithm to determine the effects of uncertainty in bus load and generation on the output of conventional power flow analysis is presented. The use of statistical moments is presented and developed as a means for representing the stochastic process. Statistical moments are used to describe the uncertainties, and facilitate the calculations of single and multivarlate probability density functions of input and output variables. The transformation of the uncertainty through the power flow equations is made by the expansion of the node equations in a multivariate Taylor series about an expected operating point. The series is truncated after the second order terms. Since the power flow equations are nonlinear, the expected values of output quantities is in general not the solution to the conventional load flow problem using expected values of input quantities. The second order transformation offers a correction vector and allows the consideration of larger uncertainties which have caused significant error in the current linear transformation algorithms. Voltage controlled busses are included with consideration of upper and lower limits. The finite reactive power available at generation sites, and fixed ranges of transformer tap movement may have a significant effect on voltage and line power flow statistics. A method is given which considers limitation constraints in the evaluation of all output quantities. The bus voltages, line power flows, transformer taps, and generator reactive power requirements are described by their statistical moments. Their values are expressed in terms of the probability that they are above or below specified limits, and their expected values given that they do fall outside the limits. Thus the algorithm supplies information about severity of overload as well as probability of occurrence. An example is given for an eleven bus system, evaluating each quantity separately. The results are compared with Monte Carlo simulation.

16806 **(DOE/ET/29185—18) Assessment of research directions for high-voltage direct-current power systems. Quarterly technical progress report, July 1-September 30, 1980.** Long, W.F. (Wisconsin Univ., Madison (USA)). Oct 1980. Contract AS02-78ET29185. 4p. NTIS, PC A02/MF A01.

The activities reported cover a variety of topics related to research on HVDC power systems which were investigated over the previous quarterly reporting period.

16807 **(DOE/ET/29185—19) Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1980-December 31, 1980.** Long, W.F. (Wisconsin Univ., Madison (USA)). Jan 1981. Contract AS02-78ET29185. 4p. NTIS, PC A02/MF A01.

Activities during this quarterly period on proposed HVDC systems research are reported. These activities include studies of HVDC converters, computerized simulation of HVDC systems, circuit breakers, and long-range planning of HVDC projects. (LCL)

16808 **(EPRI-EL—851(Vol.2)) Real-Time Digital Data-Acquisition System for determining load characteristics. Volume 2. Operating, programming, and maintenance instructions. Final report.** Podesto, B.; Lapointe, A.; Larose, G.; Robichaud, Y.; Vaillancourt, C. (Institut de Recherche de l'Hydro-Quebec, Varennes (Canada)). Mar 1981. 148p. NTIS, PC A07/MF A01.

The work sponsored under this contract included the design and construction of a Real-Time Digital Data Acquisition System (RTDDAS) to be used in substations for on-site recording and preprocessing load response data. The gathered data can be partially processed on site to compute the apparent, active and reactive powers, voltage and current rms values, and instantaneous values of

phase voltages and currents. On-site processing capability is provided for rapid monitoring of the field data to ensure that the test setup is suitable. Production analysis of field data is accomplished off-line on a central computer from data recorded on a dual-density (800/1600) magnetic tape which is IBM-compatible. Parallel channels of data can be recorded at a variable rate from 480 to 9000 samples per second per channel. The RTDDAS is housed in a 9.1 m (30-ft) trailer which is shielded from electromagnetic interference and protected by isolators from switching surges; therefore, it can operate safely in a high-voltage substation environment where the tests must sometimes be performed. Information pertaining to the installation, software operation, and maintenance of the RTDDAS designed by IREQ is presented. A list of supporting documentation supplied by Data General Corporation is given.

16809 **(EPRI-EL—1737) Dielectric testing of polysil for inexpensive underground distribution and transmission.** Lindsey, K.E.; Schroeder, J.E.; Zlotin, Y.A. (Lindsey Industries, Inc., Azusa, CA (USA)). Mar 1981. 37p. NTIS, PC A03/MF A01.

The monomer and aggregate content of POLYSIL was optimized, as well as processing techniques, to optimize the physical and electrical properties for use in underground applications. POLYSIL castings with embedded electrodes, ranging in size from 8 pounds to 13,000 pounds, have been produced. The largest polyester/styrene based POLYSIL casting weighed 13,000 pounds and the largest methyl methacrylate casting weighed 8 pounds. Statistical analysis has been performed on over 200 test specimens. Design curves for POLYSIL, as an underground insulating material, are presented.

16810 **(EPRI-EL—1745) Composite wood utility poles. Final report.** Krueger, G.P.; Lund, A.E.; Nicholas, D.D. (Michigan Technological Univ., Houghton (USA). Inst. of Wood Research). Mar 1981. 155p. NTIS, PC A08/MF A01.

An innovative approach was used to provide a substitute for solid wood poles, which have become increasingly expensive and at times are in short supply. The new poles (COMPOLES) were manufactured using a composite wood material (CWM) consisting of chemically treated wood flakes bonded together with a synthetic adhesive. The chemicals provide durability and dimensional stability. Composite wood material was produced which had strength properties comparable to those of the structural wood species. Particular attention was given to producing a high strength material with good durability. The effects of factors such as wood species, flake type, flake alignment, adhesives and preservatives were studied in this project. The COMPOLE design is not fixed by the shape of the tree. This provides flexibility in the design process, allowing the shape and cross-section dimensions to be varied. After analyzing square, hexagonal and octagonal sections, the latter was chosen for the prototype poles. The cross-section was built up from laminates of CWM with the number of laminates dependent on the stress at that point. Ten COMPOLES, 40-feet (12.2-m) long were produced. Two were tested to determine strength characteristics and the others will be field tested by several utilities. Economic analyses indicated that the composite wood poles can compete effectively in the marketplace. Longer lengths were designed and analyzed, and found to be increasingly cost effective.

16811 **(EPRI-EL—1756) Design of multiprocessor structures for simulation of power-system dynamics. Final report.** Brasch, F.M. Jr.; Van Ness, J.E.; Kang, S.C. (Northwestern Univ., Evanston, IL (USA). School of Electrical Engineering). Mar 1981. 103p. NTIS, PC A06/MF A01.

A network of computers arranged in a modified ring structure has been designed for solving in parallel the equations describing dynamic disturbances on large power systems. The operation of this network when solving a 1723-bus, 398-generator system using an algorithm based on the Bonneville Power Administration's Transient Stability Program has been simulated on a CDC 6600. The purpose of the simulation was to determine how efficiently the algorithm can be executed in parallel on this multiprocessor configuration. The critical part of this algorithm is the forward and back substitution passes through the LDU decomposed I = Y E equations. A scheduling algorithm that assigns tasks to the processors taking into account the precedence relationships necessary in the solution, the communication requirements, and the loadings on the individual processors has been developed to minimize the computing time for this part of the solution. This method gives better results than were obtained with other methods tried earlier.

16812 **(LA—8606-PR) LASL Nb_3Ge conductor development. Sixteenth quarterly progress report, April 1-June 30, 1980.** Maley, M.P. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

The 16th quarterly progress report of the Los Alamos Scientific Laboratory program to develop Nb_3Ge as a superconductor with potential applications to power transmission lines cover the period April 1-June 30, 1980. During this quarter an attempt to test our first 1-m-long Nb_3Ge cable at Brookhaven National Laboratory was unsuccessful owing to leaks in the cryogenic system. The tests are now scheduled for early July. Investigations of the influence of additions of boron and gallium to Nb_3Ge on its superconducting properties have been completed. Gallium additions produce a small decrease in T/sub c/ (~ 1.0 K) but do not appear to enhance H/sub c2/. A thermal stress analysis of the cooldown of our Nb_3Ge tapes from their deposition temperature has been completed. It appears that a large bending moment generated by differential thermal contraction between the Nb_3Ge coat and the copper substrate may be responsible for longitudinal edge cracks. The appendix describes one of the problems encountered in developing a superconductor from a copper strip coated with a thin layer of niobium-germanium (Nb_3Ge) polycrystals. The conductor was made with several thicknesses of coating, and the thick coatings developed a crack. A series of hand calculations was done to define the mechanisms involved and to try to quantify the stress levels above which the crack occurs.

16813 **(PB—80-222474) Electric fields under power lines (supplement to 'an examination of electric fields under ehv (extra-high-voltage) overhead power transmission lines'). Final report.** Wigdor, M. (Office of Radiation Programs, Silver Spring, MD (USA)). Mar 1980. 25p. NTIS, PC A02/MF A01.

The electric field strengths under 115KV electric power transmission lines was measured and compared to results from an earlier study.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 16927

16814 **(CONF-810411—) Training of nuclear facility personnel.** (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 339p. NTIS, PC A15/MF A01.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Separate abstracts are included for each of the papers presented concerning certification and standards; operations training; the human element; and non-licensed training.

16815 (CONF-810411—, pp 32-45) **Best nuclear simulator.** Bockhold, G. Jr. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

How should you specify and buy the best Nuclear Simulator. Cost and training effectiveness are the items which must be balanced, but recent purchases indicate that there is a wide variation in simulator costs from approximately 5 million dollars to 13 million dollars and that there may be differences of opinion on what is cost effective. To first focus on training effectiveness, the simulator training functions and requirements are reviewed. New simulator evaluation software is described.

16816 (CONF-810411—, pp 46-62) **Organizing for change: new priorities for training organization in the nuclear industry.** Gammuto, J.J. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Traditional training organizations will require a new look in light of the efforts being applied since TMI. the emphasis to incor-

porate basic educational technology into power plant training and trends of past, present, and future program development, point out the need for change in training philosophy and manpower needs. The functional responsibilities within a typical training organization will be described with an emphasis on interrelationships of each group activity and the effect of the systems approach to training organization and administration.

16817 (CONF-810411—, pp 63-82) **College and university programs for meeting the needs of educating nuclear power plant personnel.** Hajek, B.K.; Miller, D.W.; De Vuono, A.C. (Ohio State Univ., Columbus). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

ANS, INPO, and NRC are considering various recommendations for university courses to be required for all nuclear power plant licensed personnel. This paper discusses these recommendations and compares them with the content and constraints of traditional university academic programs. One solution being pursued by utilities in Ohio is discussed. In this program, courses are being obtained from several different educational institutions for presentation at the power plant site. The program provides sufficient flexibility so that decisions on specific degree options do not have to be made at this time.

16818 (CONF-810411—, pp 83-88) **Education and training of the shift technical advisor.** Thomas, E.L. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

This paper discusses the background and current approaches for qualifying the required position of Shift Technical Advisor (STA). Industry positions regarding the regulation are given. Problems associated with meeting the requirement are identified, along with a discussion of other alternatives for upgrading the education level of shift management. Inherent in the discussion is the conclusion that voluntary improvements in the training and education of shift management personnel are more effective than mandatory positions or degree requirements.

16819 (CONF-810411—, pp 89-94) **Shift technical advisors: in the eyes of the NRC.** Crocker, L.P. (Nuclear Regulatory Commission, Washington, DC). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Since January 1, 1980, the NRC has required that Shift Technical Advisors be on-shift at all operating nuclear power plants. The objective of the requirement is to assure that technical expertise is immediately available to each operating shift to assess off-normal events and to provide advice to control room personnel. Further, this advice and assistance is to be provided by an individual not responsible for control manipulations or for directing the activities of reactor operators. The long-term requirement for on-shift technical expertise is firm. However, the exact manner in which this expertise must be furnished has not been determined. Licensees have proposed various alternatives to meet this requirement. These proposals still are being reviewed by the NRC staff.

16820 (CONF-810411—, pp 95-104) **Academic involvement in shift technical advisor training for the utilities.** Davidson, J.N.; Sain, L.H. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

One of the clearest conclusions reached of nearly every commission and panel formed in response to the Three Mile Island accident was the desirability of upgrading the educational background of those persons with direct operational responsibility in a nuclear power plant. The long term objective is for all shift supervisors to have engineering degrees as well as NRC senior operating licenses. In the interim, the utilities are required to provide in-depth engineering expertise on every shift in the person of a Shift Technical Advisor (STA). The training of STA's is complicated by the requirement to have college level instruction in plant specific topics which are not typically included in the curricula of degree-granting instructions. One possible response to this challenge is presented.

16821 (CONF-810411—, pp 142-153) **Job and task analysis: a view from the inside.** Allison, C.E. (Florida Power and Light, Miami). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

This paper is not intended to describe how to perform a Job and Task Analysis. There are a wide variety of approaches to conducting a Job and Task Analysis, many of which have been developed by highy seasoned and skilled professionals in this field. This paper is intended to discuss the internal support, in terms of money, time, and people, required for the Job and Task Analysis Project.

16822 (CONF-810411—, pp 175-182) **Human factors in training.** Dutton, J.W.; Brown, W.R. (Washington Public Power Supply System, Richland). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

The Human Factors concept is a focused effort directed at those activities which require human involvement. Training is, by its nature, an activity totally dependent on the Human Factor. This paper identifies several concerns significant to training situations and discusses how Human Factor awareness can increase the quality of learning. Psychology in the training arena is applied Human Factors. Training is a method of communication represented by sender, medium, and receiver. Two-thirds of this communications model involves the human element directly.

16823 (CONF-810411—, pp 183-197) **Towards accurate emergency response behavior.** Sargent, T.O. (Sargent Group, Hartford, CT). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Nuclear reactor operator emergency response behavior has persisted as a training problem through lack of information. The industry needs an accurate definition of operator behavior in adverse stress conditions, and training methods which will produce the desired behavior. Newly assembled information from fifty years of research into human behavior in both high and low stress provides a more accurate definition of appropriate operator response, and supports training methods which will produce the needed control room behavior. The research indicates that operator response in emergencies is divided into two modes, conditioned behavior and knowledge based behavior. Methods which assure accurate conditioned behavior, and provide for the recovery of knowledge based behavior, are described in detail.

16824 (CONF-810411—, pp 198-229) **Plant designer's view of the operator's role in nuclear plant safety.** Corcoran, W.R.; Church, J.F.; Cross, M.T.; Porter, N.J. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

The nuclear plant operator's role supports the design assumptions and equipment with four functional tasks. He must set up th plant for predictable response to disturbances, operate the plant so as to minimize the likelihood and severity of event initiators, assist in accomplishing the safety functions, and feed back operating experiences to reinforce or redefine the safety analyses' assumptions. The latter role enhances the operator effectiveness in the former three roles. The Safety Level Concept offers a different perspective that enables the operator to view his roles in nuclear plant safety. This paper outlines the operator's role in nuclear safety and classifies his tasks using the Safety Level Concept.

16825 (CONF-810411—, pp 255-261) **Nuclear security officer training.** Harrington, W.F. (Power Authority of the State of New York). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Training has become complex and precise in today's world of critical review and responsibility. Entrusted to a security officer is the success or demise of large business. In more critical environments the security officer is entrusted with the monitoring and protection of life sensitive systems and devices. The awareness of this high visibility training requirement has been addressed by a limited few. Those involved in the nuclear power industry through dedication and commitment to the American public have without a doubt become leading pioneers in demanding training excellence.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 16852, 16861, 16862, 16864, 16871, 16874

16826 **(CONF-800592—8) Postirradiation examination of light water reactor fuel: a United States perspective.** Neimark, L.A.; Ocken, H. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01.

From International conference on postirradiation examination; Grange-Over-Sands, UK (13 May 1980).

Poolside and hot-cell postirradiation examination (PIE) have played and will continue to play a significant role in the US LWR program. The principal uses of PIE are in fuel surveillance, fuel improvement, and failure analysis programs and in the postmortem analysis of safety-related tests. Institutional problems associated with fuel shipping, waste disposal, and fuel disposal can be expected to pose obstacles to hot-cell examinations and likely result in more sophisticated poolside examinations.

16827 **(DOE/ET/34216—T1) Experimental study of advanced continuous acoustic emission monitoring of BWR components. Final report.** McElroy, J.W.; Hartman, W.F. (Philadelphia Electric Co., PA (USA)). Sep 1980. Contract AC02-78ET34216. 44p. (COO—4592-2). NTIS, PC A03/MF A01.

The program consisted of installing, maintaining, and monitoring AE sensors located on primary piping, nozzles, and valves in the BWR system. Analysis of the AE data was correlated to the results of supplementary nondestructive testing techniques used during the in-service inspection, performed at refueling outages. Purpose of the program was to develop the on-line surveillance acoustic emission technique in order to identify areas of possible structural degradation. Result of reducing inspection time was to reduce accumulated radiation exposure to inspecting personnel and to reduce the amount of critical plant outage time by identifying the critical inspection areas during operation. The program demonstrated the capability of acoustic emission instrumentation to endure the nuclear reactor environment. The acoustic emission sensors withstood 12 months of reactor operation at temperatures of 400°F and greater in high radiation fields. The preamplifiers, also mounted in the reactor environment, operated for the 12-month period in 100% humidity, 250°F conditions. The remaining cable and AE instrumentation were operated in controlled environments.

16828 **(DOE/ET/34216—T2) Investigation into continuous acoustic emission monitoring of BWR components. Semiannual report.** McElroy, J.W. (Philadelphia Electric Co., PA (USA)). 2 Jun 1980. Contract AC02-78ET34216. 81p. NTIS, PC A05/MF A01.

This report covers the work accomplished during the eight month period from October 1, 1977 through June 1, 1978. During this period, Peach Bottom Unit 3 was operational for the first six months and was shutdown for a refueling outage for the last two months. During the refueling outage, removal, recalibration, refurbishment, and reinstallation of all the AE instrumentation was performed. The coupling efficiency and the sensitivity of the sensors did not vary significantly with time. 5600 AE events were accepted showing several localized areas of concern. Five main steam safety relief valves suspected of leakage based on AE data were replaced. A leak in the recirculation system of the plant was clearly indicated and located by the AE system. Correlation between AE results and the results from alternate inservice inspection techniques has been initiated.

16829 **(GEAP—24310) Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers.** Mulcahy, T.M.; Wambsganss, M.W.; Lin, W.H.; Yeh, T.T.; Lawrence, W.P. (General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.). Jan 1981. Contract AC02-77ET34209. 124p. (ANL-CT—81-11). NTIS, PC A06/MF A01.

Data for surface pressures on a finite length rod in an annular region are presented as a function of distance along the rod and compared with existing data for well-developed flow. Normalizations of the power spectral densities for different flow rates and three hydraulic diameters are considered, and the possible spurious effects of flow noise, entrance conditions, and transducer size effects are discussed. Surface pressure power spectral density levels are identified which predict the same order of magnitude response as measured in a companion study.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 16826, 16829, 16860, 16861, 16864, 16870, 16871, 16874, 16876, 17225

16830 (CONF-810411—, pp 1-16) **Post accident training program design at Three Mile Island.** Lawyer, L.L. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

The TMI preaccident training staff typically consisted of 9 professional and 3 administrative support persons. Procedures were prepared and facilities designated for operator training. The thrust of the post accident effort was directed to expanding the training function to include all other personnel while modifying the operator training to address lessons learned. Significant experiences were encountered in part task simulation, job and task analysis, decision analysis and with various external committees. These experiences led to specific opinions on industry needs in the areas of staffing, regulation, importance of training and contractor assistance.

16831 (CONF-810411—, pp 247-254) **Health physics training at V.C. Summer Nuclear Station.** Blue, L.A.; Bellmore, J.R.; Shultz, P.A. (V.C. Summer Nuclear Station, Columbia, SC). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Health Physics training for radiation workers and Health Physics Specialists continues to receive full attention by regulatory agencies such as the NRC and ANI. Guidance for such training continues to develop in a direction which forces utilities to continuously increase the quality and quantity of their Health Physics Training Program. This occurs at a time when our rapidly growing industry is placing greatly increased demands on the available work force of highly trained nuclear workers.

16832 **Situ corrosion monitoring of steam generators.** Kendig, M.W.; Isaacs, H.S. (Brookhaven National Lab, Upton, NY). *Corrosion Science ;* **20**: No. 6, 781-789(1980).

An ac electrochemical technique that meets the basic requirements for an in situ localized corrosion monitor within the secondary coolant of PWR steam generators uses two electrodes to measure the electrochemical impedance of a surface in an occluded region with high heat flux. This impedance is related to the kinetics of corrosion and marked decreases indicate the onset of a high corrosion rate. Experiments have demonstrated the ability to determine the onset of corrosion under conditions of high solution resistance and solution agitation due to local boiling. The technique operates similarly in pressurized 300/degree/C water containing 1400 ppm Na/sub 2/SO/sub 4/. 13 refs.

2103 Power Reactors, Non-breeding, Graphite Moderated

16833 **(DOE/ET/34202—15) Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 15 Feb 1981. Contract AC02-76ET34202. 200p. NTIS, PC A09/MF A01.

Work covered in this report includes the activities associated with the status of the simulated reactor helium supply system, testing equipment and gas chemistry analysis instrumentation and equipment. The progress in the screening test program is described; this includes: screening creep results and metallographic analysis for materials thermally exposed or tested at 750°, 850°, 950° and

1050°C (1382°, 1562°, 1742° and 1922°F). The status of controlled purity helium creep-rupture testing in the intensive screening test program is discussed. The results of metallographic studies of screening alloys exposed 1000 and 3000 h at 950°C and of the wrought alloys exposed 1000 h at 1050°C are discussed.

16834 **(DOE/SF/02034—T10) High-temperature gas-cooled reactor: reformer application study.** (Gas-Cooled Reactor Associates, La Jolla, CA (USA)). Dec 1980. Contract AC03-78SF02034. 352p. NTIS, PC A16/MF A01.

This Application Study evaluates the HTGR-R with a core outlet temperature of 850°C as a near-term Lead Project and as a vehicle to long-term HTGR Program objectives. The scope of this effort included evaluation of the HTGR-R technology, evaluation of potential HTGR-R markets, assessment of the economics of commercial HTGR-R plants, and the evaluation of the program scope and expenditures necessary to establish HTGR-R technology through the completion of the Lead Project. In order to properly assess the potential of the HTGR-R and the suitability of the HTGR-R as a Lead Project, additional work must be performed before a final judgment is rendered. Design trade-off studies and alternative applications must be investigated to determine if a commercial potential exists for the HTGR-R at 850°C. If commercial incentives are only identified for the HTGR-R with core outlet temperatures greater than 850°C, the design and development program duration and cost and the demonstration path for the HTGR-R must be reassessed.

16835 **(GA-A—16217) HTGR process heat program: design and analysis. Final report, FY-80.** (General Atomic Co., San Diego, CA (USA)). Jan 1981. Contract AT03-76ET35301. 191p. NTIS, PC A09/MF A01.

This report summarizes the results of concept design studies at General Atomic Company during FY-80 for an 1170-MW(t) high-temperature gas-cooled reactor - process heat (HTGR-PH). Studies included the nuclear heat source design and cost for the reforming application denoted the HTGR-R. Additional information for the reforming application is included in separate reports designated as the FY-80 semiannual progress report and the HTGR-R Stand Alone Package Report. Other studies conducted during this time period included alternative plant configurations known as the HTGR-R mini-loop, HTGR-R direct reforming loop, and a lower temperature nuclear heat source design using molten salt as a heat transport and storage medium. This report summarizes the findings of the alternative plant configurations.

16836 **(GA-A—16283) US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981.** Turner, R.F. (General Atomic Co., San Diego, CA (USA)). Mar 1981. Contract AT03-76ET35300. 21p. NTIS, PC A02/MF A01.

The status of progress on the major milestones, as defined in Revision 2 of the Subprogram Plan, is summarized for the second quarter of FY-81. Technical highlights of the period were: continued successful operation of fuel capsule R2K13 (PWS FD-15); reports written on irradiation induced permeability change in pyrocarbon (FD-12) and post-irradiation analysis technique comparison on coated particles (FD-13); and successful operation of graphite capsules HTK-4 at ORNL (GD-1) and GC-(300°C) at Petten (GD-2).

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 16853, 16865, 16866, 16867, 16868, 16869, 16872

16837 **(ANL—80-97) Thermal-performance study of liquid metal fast breeder reactor insulation.** Shiu, K.K. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 155p. NTIS, PC A08.

Thesis. Submitted to University of Illinois, Urbana.

Three types of metallic thermal insulation were investigated analytically and experimentally: multilayer reflective plates, multilayer honeycomb composite, and multilayer screens. Each type was subjected to evacuated and nonevacuated conditions, where thermal measurements were made to determine thermal-physical characteristics. A variation of the separation distance between adjacent reflective plates of multilayer reflective plates and multilayer screen insulation was also experimentally studied to reveal its significance. One configuration of the multilayer screen insulation was further selected to be examined in sodium and sodium oxide environments. The emissivity of Type 304 stainless steel used in comprising the insulation was measured by employing infrared technology. A comprehensive model was developed to describe the different proposed types of thermal insulation. Various modes of heat transfer inherent in each type of insulation were addressed and their relative importance compared. Provision was also made in the model to allow accurate simulation of possible sodium and sodium oxide contamination of the insulation. The thermal-radiation contribution to heat transfer in the temperature range of interest for LMFBR's was found to be moderate, and the suppression of natural convection within the insulation was vital in preserving its insulating properties. Experimental data were compared with the model and other published results. Moreover, the three proposed test samples were assessed and compared under various conditions as viable LMFBR thermal insulations.

16838 **(GA-A—15406(add.)) Gas-cooled fast breeder reactor. Quarterly progress report, February 1, 1979-April 30, 1979.** (General Atomic Co., San Diego, CA (USA)). May 1979. Contract AT03-76SF71023. 22p. NTIS, PC A02/MF A01.

The purpose of this subtask is to design and develop analytical methods and experimental programs to evaluate the reference design of the reactor shields. This evaluation is expected to cover nonuniform temperature distribution, material behavior, seismic effects, hydrodynamic tests, and structural analysis. Alternate shield configurations will also be studied so that a satisfactory and optimized shield design can be developed. During this quarter, both the up-flow and down-flow conceptual shielding designs were revised. In the case of up-flow, the PCRV duct shielding problem was alleviated. In down-flow, the conceptual design was revised to reflect the impact of the core lteral restraint on the shielding structures.

16839 **(GEFR-SP—146) Influence of core-assembly refueling requirements on LMFBR core-system design.** Fox, J.N. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 1 Mar 1979. Contract AT03-76SF71031. 28p. (CONF-790615—29). NTIS, PC A03/MF A01.

From 3. US national congress on pressure vessels and piping; San Francisco, CA, USA (25 Jun 1979).

Liquid metal fast breeder reactor (LMFBR) core assemblies are exposed to an operational environment which induces permanent distortions in their main structural members. These distortions have a substantial impact on core assembly refueling since the distortions are large compared to the available spaces. Core assembly refueling requirements demand that refueling be accomplished without damage to the adjacent core components or to the refueling equipment. This paper describes the core assembly refueling requirements and the design procedures used to demonstrate compliance with the requirements. This paper also provides an assessment relative to the influence of these requirements on LMFBR core system design.

16840 **(GEFR-SP—148) Inelastic behavior of a dissimilar-metal-welded pipe transition joint: comparison of experimental measurements and analytical prediction.** Yang, T.M.; Dalcher, A.W. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Jun 1979. Contract AT03-76SF70030. 37p. (CONF-800513—4). NTIS, PC A03/MF A01.

From 4. international conference on pressure vessel technology; London, UK (19 May 1980).

The subject study involved the prediction and observed behavior of a dissimilar metal pipe joint made from 2 1/4 Cr-1Mo steel welded to Type 316 austenitic stainless steel using a nickel-base filler metal, ERNiCr-3. A two-dimensional axi-symmetric finite element model was employed in the analysis, with certain assumptions made relative to the initial stress state of the joint. Internal pressure and thermal loadings which simulated the test conditions experienced by the joint, were used as inputs. Uni-axial stress-strain

relationships and creep equations were applied to the multi-axial stress state through the concept of effective stress and equivalent strain. The analysis indicated that the loading history during the preparatory period (before acutal service) has a significant effect on the behavior of the transition joint in its early service life. The magnitudes of the stresses created at the vicinity of the dissimilar metal interfaces, mainly due to the differences in thermal expansions of the metals, are sufficient to yield the metals, and fast thermal down transients during service will induce more yielding of the metals before shakedown occurs. Calculated plastic ratchetting and creep responses of the joint metals were compared with ORNL strain measurements of the test joint. Very good agreement was shown to exist between the predictions and measurements.

16841 **(HEDL-SA—2116) Continuous gamma-ray spectrometry in the Fast Flux Test Facility.** Gold, R.; Kaiser, B.J.; Moore, F.S.; Bunch, W.L.; McElroy, W.N.; Sheen, E.M. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 20p. (CONF-800942—21). NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Gamma-ray continua have been measured at startup in the Fast Flux Test Facility (FFTF). A special FFTF insert, called the In-Reactor Thimble (IRT), provided an adequate environment for in-situ operation of the gamma spectrometer. The IRT replaced a fuel assembly near core center (No. 2101) and measurements were conducted at three axial locations, namely midplane, the lower axial shield, and the upper axial reflector. Observations were carried out with Compton Recoil Gamma-Ray Spectrometry at the state-of-the-art. Advantage was thereby taken of the most recent advances, including extension of gamma-ray spectrometry up to roughly 7 MeV with the new in-situ Janus detector probe. On this basis, in-core gamma-ray continua results are presented for FFTF.

16842 **(HEDL-SA—2200) Quality engineering in FFTF irradiation tests.** Caplinger, W.H. (Westinghouse Hanford Co., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 5p. (CONF-8010169—1). NTIS, PC A02/MF A01.

From 1980 ASQC western regional conference; Portland, OR, USA (16 Oct 1980).

The design and fabrication of an irradiation test for the Fast Flux Test Facility are planned, controlled and documented in accordance with the Department of Energy standards. Tests built by Westinghouse Hanford Company are further controlled and guided by a series of increasingly specific documents, including guidelines for program control, procedures for engineering operations, standard practices and detailed operating procedures. In response to this guidance, a series of five documents is prepared covering each step of the experiment from conception through fabrication and assembly. This paper describes the quality assurance accompanying these five steps.

16843 **(HEDL-TME—81-4) Mechanical properties of type 316 stainless steel materials after irradiation at 515°C and 585°C.** Blackburn, L.D.; Greenslade, D.L.; Ward, A.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1981. Contract AC14-76FF02170. 86p. NTIS, PC A05/MF A01.

Three different heats of type 316 SS base metal plate metals and three different weld metals produced by shielded metal arc, submerged arc, and gas tungsten arc processes with type 316 SS filler metal were used in the Gas-Cooled Fast Reactor (GCFR) Structural Materials Irradiation Experiment. Pre-irradiation strength and ductility properties over the range 24°C to 650°C were very similar for the three base metal heats and were within the expected range for this alloy. The three welds showed variations in strength and ductility before irradiation, but properties were generally within the range of previous experience for austenitic stainless steel welds. Weld metals showed higher yield strength but lower uniform and total elongations than those of base metal.

16844 **(LA—8742-PR) Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, October 1-December 31, 1980.** Maraman, W.J. (comp.). (Los Alamos Scientific Lab., NM (USA)). Mar 1981. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

This project is directed toward the examination and comparison of the effects of neutron irradiation on Liquid Metal Fast Breeder Reactor (LMFBR) Program fuel materials. Unirradiated and irradiated materials will be examined as requested by the Reference Fuels System Branch of the Division of Reactor Research and Technology (DRRT). Capabilities have been established and are being expanded for providing conventional preirradiation and postirradiation examinations. Nondestructive tests will be conducted in a hot-cell facility specifically modified for examining irradiated prototype fuel pins at a rate commensurate with schedules established by DRRT.

16845 **(ORNL—5690) Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators.** McCulloch, R.W.; Post, D.W.; Lovell, R.T.; Snyder, S.D. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 72p. NTIS, PC A04/MF A01.

Variable-width ribbon heating elements that provide a chopped-cosine variable heat flux profile have been fabricated for fuel pin simulators used in test loops by the Breeder Reactor Program Thermal-Hydraulic Out-of-Reactor Safety test facility and the Gas-Cooled Fast Breeder Reactor-Core Flow Test Loop. Thermal, mechanical, and electrical design considerations are used to derive an analytical expression that precisely describes ribbon contour in terms of the major fabrication parameters. These parameters are used to generate numerical control tapes that control ribbon cutting and winding machines. Infrared scanning techniques are developed to determine the optimum transient thermal profiie of the coils and relate this profile to that generated by the coils in completed fuel pin simulators.

16846 **(ORNL—5756) Final analysis of the GCFR radial blanket and shield integral experiment.** Ingersoll, D.T.; Williams, L.R. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 103p. NTIS, PC A06/MF A01.

An integral experiment has been performed for verification of radiation transport methods and nuclear data used in the design of the radial shield for the proposed gas-cooled fast breeder reactor demonstration plant. The experiment was conducted at the ORNL Tower Shielding Facility and consisted of integral and spectral measurements of the neutron and gamma-ray flux transmitted through slabs of materials which modeled a GCFR-type radial blanket and radial shield. Both UO_2 and ThO_2 blankets were investigated as well as several shield designs comprising stainless steel, graphite, and boronated graphite.

2107 Regulation And Licensing

16847 (CONF-810411—, pp 17-31) **Revision to ANSI/ANS 3.1 1978: resulting from TMI-2.** Palmer, F.A. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

The personnel errors which occurred at TMI-2 brought forth several areas of weaknesses in personnel selection, qualification and training that impacted ANS-3. As a result, the ANS-3 Committee started working on a revision to ANSI/ANS 3.1-1978 Standard in May 1979. In July 1979 the first set of official recommendations was issued in NUREG 0578. Due to the interim nature of these regulations some interpretation of the intent of these recommendations had to be made and a basis developed to justify changes to the standard.

16848 **(NE-F—3-6T(Rev.)(3-81)) Nondestructive examination (supplement to ASME Boiler and Pressure Vessel Code, Section V).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Mar 1981. 17p. Nuclear Standards Management Center, Oak Ridge, TN.

This standard supplements the requirements of the 1980 edition of the ASME Boiler and Pressure Vessel Code (ASME Code), Section V. When this standard is invoked or referenced, the applicable subsections of Section V are also invoked or referenced. The user is responsible for obtaining and applying the edition and revisions of this standard that supplement the edition and Addenda of the ASME Code that are applicable at the time of use. Information is presented concerning radiographic examination, ultrasonic examination, liquid penetrant testing, magnetic particle testing, and leak testing.

2109 Process Heat Reactors

REFER ALSO TO CITATION(S) 16833, 16834, 16835

22 NUCLEAR REACTOR TECHNOLOGY

2202 Components And Accessories

REFER ALSO TO CITATION(S) 17114

16849 **(EPRI-NP—1734) Development of a plastic fracture methodology. Final report.** Kanninen, M.F.; Hahn, G.T.; Broek, D.; Stonesifer, R.B.; Marschall, C.W.; Abou-Sayed, I.S.; Zahoor, A. (Battelle Columbus Labs., OH (USA)). Mar 1981. 210p. NTIS, PC A10/MF A01.

A number of candidate fracture criteria were investigated to determine the basis for plastic fracture mechanics assessments of nuclear pressure vessels and other components exhibiting fully ductile behavior. The research was comprised of an integrated combination of stable crack growth experiments and elastic-plastic finite element analyses. The results demonstrated that many different fracture criteria can be used as the basis of a resistance curve approach to predicting stable crack growth and fracture instability. All have some disadvantages and none is completely unacceptable. On balance, the best criteria were found to be the J-integral for initiation and limited amounts of stable crack growth and the local crack tip opening angle for extended amounts of stable growth. A combination of the two, which may preserve the advantages of each while reducing their disadvantages, was also suggested by these results.

16850 **(NE-E—15-2NC-T(1-81)) Class 2 nuclear components (supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NCA and NC).** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jan 1981. 32p. NTIS, PC A03/MF A01.

This standard supplements the rules for the construction of nuclear components that are covered by Subsections NCA and NC of the 1980 Edition of the ASME Boiler and Pressure Vessel Code, Section III.

2203 Fuel Elements

16851 **Nuclear reactor fuel element.** Crouthamel, C.E.; Johnson, C.E. (to Department of Energy). US Patent 4,229,260. 21 Oct 1980. Filed date 2 Jun 1976. vp.

PAT-APPL-692161.

A nuclear reactor fuel element is described which has an outer cladding, a central core of fissionable or mixed fissionable and fertile fuel material and a layer of oxygen gettering material on the inner surface of the cladding. The gettering material reacts with oxygen released by the fissionable material during irradiation of the core thereby preventing the oxygen from reacting with and corroding the cladding. Also described is an improved method for coating the inner surface of the cladding with a layer of gettering material.

2204 Control Systems

16852 **(CONF-810411—, pp 165-174) Use of task analysis in control room evaluations.** Ross, K.C. Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

Responding to recently formulated regulatory requirements, the BWR Owners' Group, working in conjunction with General Electric, has formulated a method for performing human factors design reviews of nuclear power plant control rooms. This process incorporates task analyses to analyze operational aspects of panel layout and design. Correlation of operator functions defined by emergency procedures against required controls and displays has proven successful in identifying instrumentation required in the control room to adequately respond to transient conditions, and in evaluating the effectiveness of panel design and physical arrangement. Extensions of the analysis have provided information on operator response paths, frequency of use of instruments, and control room layout. The techniques used were based on a need to identify primary controls and indications required by the operator in performing each step of the applicable procedure. The relative locations of these instruments were then analyzed for information on the adequacy of the control room design for those conditions.

16853 **Method and apparatus for reducing the power level in a nuclear reactor during temperature transient.** Zebroski, E.L. (to Electric Power Research Institute). US Patent 4,227,967. 14 Oct 1980. Filed date 3 Jun 1977. vp.

Apparatus is described for reducing the power level in a nuclear reactor during a transient increase in temperature of the primary coolant. The apparatus includes a neutron absorber and a thermally elongatable member adapted for moving the absorber into closer proximity with the core. The elongatable member is sensitive to the temperature of the primary coolant and moves the absorber by its thermal elongation. The elongatable member includes means for amplifying its thermal elongation so that the motion of the absorber member is amplified.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 17380, 17381, 17382, 17403, 17406, 17407, 17549

16854 **(BNL—51306) Programs and subroutines for calculating cadmium body burdens based on a one-compartment model.** Robinson, C.V.; Novak, K.M. (Brookhaven National Lab., Upton, NY (USA)). Aug 1980. Contract AC02-76CH00016. 21p. NTIS, PC A02/MF A01.

A pair of FORTRAN programs for calculating the body burden of cadmium as a function of age is presented, together with a discussion of the assumptions which serve to specify the underlying, one-compartment model. Account is taken of the contributions to the body burden from food, from ambient air, from smoking, and from occupational inhalation. The output is a set of values for ages from birth to 90 years which is either longitudinal (for a given year of birth) or cross-sectional (for a given calendar year), depending on the choice of input parameters.

16855 **(ORNL/TM—7412) Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case.** Adams, S.M.; Vaughan, D.S.; Hildebrand, S.G.; Kumar, K.D. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 103p. NTIS, PC A06/MF A01.

Assessment approaches and strategies useful in addressing important issues in section 316(b) of the 1972 Federal Water Pollution Control Act are illustrated in this report through the analysis and evaluation of the Prairie Island Nuclear Station 316(b) data base. The main issues in 316(b) demonstrations, cooling water intake operation and location, involve determining the impacts of entrainment and impingement. Entrainment impacts were addressed by applying the equivalent adult approach and correcting for inherent biases and by determining the through-plant survival of zooplankton. An assessment of impingement impacts was made by comparing for each of various species the number of fish impinged

to estimates of population size. Densities of plankton and fish were compared between the intake area and an alternate area to determine if the location of the present intake minimizes impacts. No definitive conclusion relative to the best location of the intake could be made because of high year to year variability in the data and the differential dominance of trophic groups between areas.

2206 Research, Test, And Experimental Reactors

16856 **(CONF-800592—9) Post-irradiation handling and examination at the HFEF complex.** Bacca, J.P. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01.

From International conference on postirradiation examination; Grange-Over-Sands, UK (13 May 1980).

The Hot Fuel Examination Facility provides postirradiation handling and examination of fast reactor irradiation experiments and safety tests for the United States Breeder Reactor Program. Nondestructive interim examinations and destructive terminal examinations at HFEF derive data from tests irradiated in the Experimental Breeder Reactor No. II, in the Transient Reactor Test Facility (TREAT), and in the Sodium Loop Safety Facility. Similar support will be provided in the near future for tests irradiated in the Fast Flux Test Facility, and for the larger sodium loops to be irradiated in TREAT.

16857 **(HEDL-SA—1985) Fire protection at the Fast Flux Test Facility (a sodium cooled test reactor).** Bell, J.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 19 Sep 1980. Contract AC14-76FF02170. 8p. (CONF-801189—1). NTIS, PC A02/MF A01.

From National Fire Protection Association fall meeting; San Diego, CA, USA (17 Nov 1980).

For purposes of this presentation, fire protection at the FFTF is subdivided into two catagories; protection for non-sodium areas and protection for areas containing sodium. Fire protection systems and philosophies for non-sodium areas at the FFTF are very similar to those used at conventional power plants being constructed throughout the country. They follow, essentially, the NRC rules and guidelines and ANSI 59.4 Generic Requirements for Light Water Nuclear Power Plant Fire Protection. The FFTF with its support facilities have their own water system comprised of a looped 8" and 10" underground distribution system, three 1500 GPM fire pumps and three ground level storage tanks totaling 736,000 gallons with 420,000 reserved for fire protection. Fire hydrants are enclosed with hose houses outfitted for use by the Emergency Response Team (ERT). Fire prevention systems for sodium areas of the FFTF are also described.

2207 Plutonium And Isotope Production Reactors

16858 **(ORNL/TM—7754) High flux isotope reactor quarterly report, April, May, and June of 1980.** Corbett, B.L.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

Routine reactor operation with four end-of-cycle shutdowns and one unscheduled shutdown resulted in an on-stream time of 95.4% for the quarter. The outer control plates were replaced, and a semiannual core component inspection was made.

2208 Propulsion Reactors

16859 **(LA-UR—81-703) Reactors for nuclear electric propulsion.** Buden, D.; Angelo, J.A. Jr. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 12p. (CONF-810439—2). NTIS, PC A02/MF A01.

From 15. AIAA/JSASS/DGLR international electromagnetic propulsion conference; Las Vegas, NV, USA (21 Apr 1981).

Propulsion is the key to space exploitation and power is the key to propulsion. This paper examines the role of nuclear fission reactors as the primary power source for high specific impulse electric propulsion systems for space missions of the 1980s and 1990s. Particular mission applications include transfer to and a reusable orbital transfer vehicle from low-Earth orbit to geosynchronous orbit, outer planet exploration and reconnaissance missions, and as a versatile space tug supporting lunar resource development. Nuclear electric propulsion is examined as an indispensable component in space activities of the next two decades.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 16557, 16824, 17225

16860 **(CONF-801053—11) Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA.** Yackle, T.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01.

From 8. water reactor safety research information meeting; Gaithersburg, MD, USA (27 Oct 1980).

A second series of thermocouple effects tests (TC-3) is being conducted in the Power Burst Facility (PBF) at the Idaho National Engineering Laboratory (INEL). These tests are designed to evaluate the influence of external surface thermocouples on the behavior of nuclear fuel rods during a large break loss-of-coolant accident (LOCA) experiment, which includes partial or total rod rewet during blowdown. Questions have been raised with regard to possible effects of surface thermocouples on the thermal behavior of in-pile and out-of-pile test rods. The TC-3 test series, currently being conducted at the PBF, is an extension of the TC-1 tests with four LOFT-type fuel rods contained in individual flow shrouds. The fuel rods are symmetrically positioned within a test train in the PBF in-pile tube in an environment similar to the LOFT test environment.

16861 **(CONF-810235—1) Graphic display of spatially distributed binary-state experimental data.** Watson, B.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 4p. NTIS, PC A02/MF A01.

From SPIE technical symposium; Los Angeles, CA, USA (9 Feb 1981).

Experimental data collected from a large number of transducers spatially distributed throughout a three-dimensional volume has typically posed a difficult interpretation task for the analyst. This paper describes one approach to alleviating this problem by presenting color graphic displays of experimental data; specifically, data representing the dynamic three-dimensional distribution of cooling fluid collected during the reflood and refill of simulated nuclear reactor vessels. Color-coded binary data (wet/dry) are integrated with a graphic representation of the reactor vessel and displayed on a high-resolution color CRT. The display is updated with successive data sets and made into 16-mm movies for distribution and analysis. Specific display formats are presented and extension to other applications discussed.

16862 **(CONF-810307—3) TRAC-BD1: transient reactor analysis code for boiling-water systems.** Spore, J.W.; Weaver, W.L.; Shumway, R.W.; Giles, M.M.; Phillips, R.E.; Mohr, C.M.; Singer, G.L.; Aguilar, F.; Fischer, S.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1981. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01.

From 3. specialist meeting on transient two-phase flow; Pasadena, CA, USA (23 Mar 1981).

The Boiling Water Reactor (BWR) version of the Transient Reactor Analysis Code (TRAC) is being developed at the Idaho National Engineering Laboratory (INEL) to provide an advanced best-estimate predictive capability for the analysis of postulated accidents in BWRs. The TRAC-BD1 program provides the Loss of Coolant Accident (LOCA) analysis capability for BWRs and for many BWR related thermal hydraulic experimental facilities. This code features a three-dimensional treatment of the BWR pressure vessel; a detailed model of a BWR fuel bundle including multirod, multibundle, radiation heat transfer, leakage path modeling capability, flow-regime-dependent constitutive equation treatment, reflood tracking capability for both falling films and bottom flood quench fronts, and consistent treatment of the entire accident sequence. The BWR component models in TRAC-BD1 are described and comparisons with data presented. Application of the code to a BWR6 LOCA is also presented.

16863 (CONF-810411—, pp 129-141) **Licensee event report sequence coding and search procedure: a training tool.** Gallaher, R.B. (Nuclear Regulatory Commision, Washington, DC). Apr 1981.

From 4. symposium on training of nuclear facility personnel; Gatlinburg, TN, USA (27 Apr 1981).

At the request of the Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD), the Nuclear Safety Information Center (NSIC) has undertaken the development of a detailed computer-compatible coding system for events and sequences of occurrences described in Licensee Event Reports (LERs). This task was conceived by AEOD and is designated the LER Sequence Coding and Search Procedure. The coding system is intended to describe the sequence of events detailed in the LER in a computer-readable and computer-searchable format. The NSIC has developed coding tables, a coding form and compatible computer software to permit storage and on-line computer search capability. The AEOD draft Watch List has been revised to categorize and retrieve identified situations of interest. The coding system provides an orderly presentation of occurrences that resulted because of an initiating event. The sequences could be used for training operators and maintenance personnel in transients that have actually occurred.

16864 **(CONF-810434—1) Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters.** Davis, C.F. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

From 2. international symposium on flow; St Louis, MO, USA (6 Apr 1981).

Transient Time Flowmeters (TTF) have been given much interest in various water reactor safety programs as a method of determining a two-phase flow velocity. The determination of velocity by measuring the time interval tau for the passage of a flow disturbance between two points seems very logical. However, the major problem is how to experimentally determine this time interval, then how to interpret the velocity once it has been calculated. At ORNL, two Ramapo Inc. drag flowmeters have been tested in vertical two-phase air-water flow with good results. Three different configurations have been studied: in the first a drag body was placed 15.2 cm (6 in.) downstream of the other, in the second the separation was 29.2 cm (11.5 in.), and in the third the separation was 62.2 cm (24.5 in.).

16865 **(CONF-810434—3) Application of a vortex shedding flowmeter to the wide range measurement of high temperature gas flow.** Baker, S.P.; Ennis, R.M. Jr.; Herndon, P.G. (Oak Ridge National Lab., TN (USA); TRW, Inc., Oak Ridge, TN (USA). Energy Systems Group). 1981. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

From 2. international symposium on flow; St Louis, MO, USA (6 Apr 1981).

A single flowmeter was required for helium gas measurement in a Gas Cooled Fast Breeder Reactor loss of coolant simulator. Volumetric flow accuracy of +-1.0% of reading was required over the Reynolds Number range 6 x 10^3 to 1 x 10^6 at flowing pressures from 0.2 to 9 MPa (29 to 1305 psia) at 350°C (660°F) flowing temperature. Because of its inherent accuracy and rangeability, a vortex shedding flowmeter was selected and specially modified to provide for a remoted thermal sensor. Experiments were conducted to determine the relationship between signal attenuation and sensor remoting geometry, as well as the relationship between gas flow parameters and remoted thermal sensor signal for both compressed air and helium gas. Based upon the results of these experiments, the sensor remoting geometry was optimized for this application. The resultant volumetric flow rangeability was 155:1. The associated temperature increase at the sensor position was 9°C above ambient (25°F) at a flowing temperature of 350°C. The volumetric flow accuracy was measured over the entire 155:1 flow range at parametric values of flowing density. A volumetric flow accuracy of +- % of reading was demonstrated.

16866 **(DOE/ET/37218—1) Development of computer code models for analysis of subassembly voiding in the LMFBR.** Hinkle, W. (ed.). (Massachusetts Inst. of Tech., Cambridge (USA)). Dec 1979. Contract AS02-78ET37218. 162p. NTIS, PC A08/MF A01.

The research program discussed in this report was started in FY1979 under the combined sponsorship of the US Department of Energy (DOE), General Electric (GE) and Hanford Engineering Development Laboratory (HEDL). The objective of the program is to develop multi-dimensional computer codes which can be used for the analysis of subassembly voiding incoherence under postulated accident conditions in the LMFBR. Two codes are being developed in parallel. The first will use a two fluid (6 equation) model which is more difficult to develop but has the potential for providing a code with the utmost in flexibility and physical consistency for use in the long term. The other will use a mixture (< 6 equation) model which is less general but may be more amenable to interpretation and use of experimental data and therefore, easier to develop for use in the near term. To assure that the models developed are not design dependent, geometries and transient conditions typical of both foreign and US designs are being considered.

16867 **(DOE/ET/37218—2) Development of a model to predict flow oscillations in low-flow sodium boiling.** Levin, A.E.; Griffith, P. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Apr 1980. Contract AS02-78ET37218. 252p. (MIT-EL—80-006). NTIS, PC A12/MF A01.

Tests performed in a small scale water loop showed that voiding oscillations, similar to those observed in sodium, were present in water, as well. An analytical model, appropriate for either sodium or water, was developed and used to describe the water flow behavior. The experimental results indicate that water can be successfully employed as a sodium simulant, and further, that the condensation heat transfer coefficient varies significantly during the growth and collapse of vapor slugs during oscillations. It is this variation, combined with the temperature profile of the unheated zone above the heat source, which determines the oscillatory behavior of the system. The analytical program has produced a model which qualitatively does a good job in predicting the flow behavior in the wake experiment. The amplitude discrepancies are attributable to experimental uncertainties and model inadequacies. Several parameters (heat transfer coefficient, unheated zone temperature profile, mixing between hot and cold fluids during oscillations) are set by the user. Criteria for the comparison of water and sodium experiments have been developed.

16868 **(DOE/ET/37218—3) Development of models for the sodium version of the two-phase three-dimensional thermal hydraulics code THERMIT.** Wilson, G.J.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA)). May 1980. Contract AS02-78ET37218. 179p. (MIT-EL—80-010). NTIS, PC A09/MF A01.

Several different models and correlations were developed and incorporated in the sodium version of THERMIT, a thermal-hydraulics code written at MIT for the purpose of analyzing transients under LMFBR conditions. This includes: a mechanism for the inclusion of radial heat conduction in the sodium coolant as well as radial heat loss to the structure surrounding the test section. The fuel rod conduction scheme was modified to allow for more flexibility in modelling the gas plenum regions and fuel restructuring. The formulas for mass and momentum exchange between the liquid and vapor phases were improved. The single phase and two phase friction factors were replaced by correlations more appropriate to LMFBR assembly geometry.

16869 **(DOE/ET/37218—4) Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies.** Granziera, M.R.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). May 1980. Contract AS02-78ET37218. 367p. NTIS, PC A16/MF A01.

A two dimensional numerical model for the simulation of sodium boiling transient was developed using the two fluid set of conservation equations. A semiimplicit numerical differencing scheme capable of handling the problems associated with the ill-posedness implied by the complex characteristic roots of the two fluid

problems was used, which took advantage of the dumping effect of the exchange terms. Of particular interest in the development of the model was the identification of the numerical problems caused by the strong disparity between the axial and radial dimensions of fuel assemblies. A solution to this problem was found which uses the particular geometry of fuel assemblies to accelerate the convergence of the iterative technique used in the model. Three sodium boiling experiments were simulated with the model, with good agreement between the experimental results and the model predictions.

16870 **(EGG/GEND—003) TMI-2 Information and Examination Program, Technical Integration Office. Annual report.** (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1981. Contract AC07-76ID01570. 56p. NTIS, PC A04/MF A01.

This annual progress report includes all activities conducted under the DOE portion of the TMI-2 Information and Examination Program during Fiscal Year 1980, which consists of tasks in the following major areas: instrumentation and electrical equipment survivability; radioactivity and environment; configuration, document control and archives; and reactor core and fuel examination. The report is prepared to provide interested personnel within the nuclear industry with a description of the program activities from its inception through September 30, 1980. This report has been prepared with the intent of stimulating interest in specific program activities to ensure the results of the program provide maximum benefit to the nuclear industry and assist in resolution of specific concerns.

16871 **(EPRI-NP—1747) Review of proposed improvements, including filter/vent of BWR pressure-suppression and PWR ice containments. Final report.** Levy, S.; Gerber, T.L.; Roy, G.; Wanner, A. (Levy (S.), Inc., Campbell, CA (USA)). Apr 1981. 215p. NTIS, PC A10/MF A01.

A state-of-the-art review of improvements including filter/vent of BWR pressure suppression and PWR ice containments has been carried out. It includes a summary description of operating and planned BWR pressure suppression and PWR ice containments; a review of improvements proposed to-date; an assessment and an updating of the risks associated with the various containment failure modes as developed in the Reactor Safety Study; the formulation of a design improvement strategy based upon the dominant risk scenarios; an evaluation of various potential preventive and mitigation concepts and, in particular, the application of filter/vent systems; and finally, a set of recommendations.

16872 **(HEDL-SA—2121-FP) Large-scale tests of aqueous scrubber systems for LMFBR vented containment.** McCormack, J.D.; Hilliard, R.K.; Postma, A.K. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 21p. (CONF-801038—20). NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Six large-scale air cleaning tests performed in the Containment Systems Test Facility (CSTF) are described. The test conditions simulated those postulated for hypothetical accidents in an LMFBR involving containment venting to control hydrogen concentration and containment overpressure. Sodium aerosols were generated by continously spraying sodium into air and adding steam and/or carbon dioxide to create the desired Na_2O_2, Na_2CO_3 or NaOH aerosol. Two air cleaning systems were tested: (a) spray quench chamber, educator venturi scrubber and high efficiency fibrous scrubber in series; and (b) the same except with the spray quench chamber eliminated. The gas flow rates ranged up to 0.8 m^3/s (1700 acfm) at temperatures to 313°C (600°F). Quantities of aerosol removed from the gas stream ranged up to 700 kg per test. The systems performed very satisfactorily with overall aerosol mass removal efficiencies exceeding 99.9% in each test.

16873 **(LA-UR—81-681) Controlling hydrogen behavior in light water reactors.** Cullingford, H.S.; Edeskuty, F.J. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 15p. (CONF-810120—8). NTIS, PC A02.

From Workshop on the impact of hydrogen on water reactor safety; Albuquerque, NM, USA (26 Jan 1981).

In the aftermath of the incident at Three Mile Island Unit 2 (TMI-2), a new and different treatment of the Light Water Reactor (LWR) risks is needed for public safety because of the specific events involving hydrogen generation, transport, and behavior following the core damage. Hydrogen behavior in closed environments such as the TMI-2 containment building is a complex phenomenon that is not fully understood. Hence, an engineering approach is presented for prevention of loss of life, equipment, and environment in case of a large hydrogen generation in an LWR. A six-level defense strategy is described that minimizes the possibility of ignition of released hydrogen gas and otherwise mitigates the consequences of hydrogen release. Guidance is given to reactor manufacturers, utility companies, regulatory agencies, and research organizations committed to reducing risk factors and insuring safety of life, equipment, and environment.

16874 **(SAND—81-0473) Light water reactor safety technology program. Quarterly report, October-December 1980.** Dahlgren, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01.

The Program was initiated in FY 1978 and has evolved during FY 1979 and FY 1980. The areas of activity during the last quarter are reported and have been broadly categorized as follows: management support program; risk methods utilization; improved safety systems; man-machine interface; safety data; and utility training.

16875 **Reporter at large: Three Mile Island. II. The paper trail.** Ford, D. *New Yorker, The ;* 46-48, 51-53, 57, 60, 63-64, 69-70, 73-74, 77-78, 81-82, 87-88, 91-92, 95-96, 98-101, 103-109(13 Apr 1981).

With a regulatory process that remained in fundamental disarray, it was apparent to some observers, at least-that sooner or later the government's overambitious nuclear program was going to get into trouble. Indeed, looking back over AEC and NRC records, one can follow what one senior NRC official calls the paper trail that documents the detailed foreknowledge, on the part of both the nuclear industry and the federal government, of the specific safety problems that culminated in the Three Mile Island accident of March 28, 1979.

16876 **Reporter at large: Three Mile Island. I. Class nine accident.** Ford, D. *New Yorker, The ;* 49-50, 53-54, 56, 61, 64, 67-68, 70, 73-74, 76, 79-80, 82, 85-86, 89-90, 95-96, 99-100, 104, 106, 108-110, 112, 114-116, 118, 119(6 Apr 1981).

A thorough discussion is presented of the background to the March 28, 1979 accident at Three Mile Island-2 Reactor. Among the factors involved in the accident include improper maintenance, sloppy operating and testing procedures, valve problems, written procedures instead of built-in design features to prevent human errors, reliance on the utilities to write these procedures, etc. (DLC)

25 ENERGY STORAGE

2504 Capacitor Banks

16877 **(SAND—81-0067C) Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar.** Edwards, L.R. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 5p. (CONF-810240—1). NTIS, PC A02/MF A01.

From Symposium on capacitor technologies, applications and reliability; Huntsville, AL, USA (24 Feb 1981).

Sandia National Laboratories is currently interested in the development of a polymer film capacitor that is tolerant to radiation. The capacitors are to be utilized in a high voltage-plus discharge application. Radiation response data at high dose/dose rate levels are presented for polyvinylidene fluoride (PVF_2), polysulfone, and Mylar. The results show that PVF_2 is the most radiation tolerant while Mylar is the least tolerant. The data also show that the radiation response is quite dependent on operating electric stress. Although PVF_2 has good radiation tolerance and a dielectric

constant which is a factor of three larger than Mylar and polysulfone, PVF_2 has properties which complicate its use as a capacitor dielectric. Electrical properties of these materials will be presented and discussed.

2505 Flywheels

16878 (CONF-791258—(Summ.)) First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS). Hampel, V.E.; Gallo, L.E.; Kawin, R.A.; Kopytoff, V.; McGrogan, S.; O'Connell, L.G.; Pavel, G.; Schriebman, J.A.; Swanson, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1979. Contract W-7405-ENG-48. 322p. NTIS, PC A11/MF A01.

From DOE/LLL workshop on the DOE/STOR technical management information system (TMIS); Pine Mountain, GA, USA (6 Dec 1979).

Abbreviated summaries and visual material used during the 2-day workshop of the DOE/STOR Technical Management Information System (TMIS) at Pine Mountain, Georgia are presented. Sixty-five representatives from government, industry, and the DOE national laboratories attended this workshop. It consisted of a series of lectures, tutorials, and hands-on, personal instructions with twelve on-line graphics terminals, multiplexed to the TMIS computer at LLL. At the time of the demonstration, TMIS provided for DOE/STOR administrators and project personnel 54 different data files, 12 models for econometric predictions and performance evaluation of electric and hybrid vehicles, electronic mail and conferencing, and automated access to 16 other information centers and computers. The main emphasis during FY 80/81 TMIS operation is on the use of energy storage systems in automobiles and transportation. TMIS is unique in that it provides for its users in one integrated system the totality of programmatic files required for the conduct of a national program: administrative data, bibliographic compendia, numeric data for components and systems, evaluation criteria, and interactive models by which such systems can be intercompared and econometric predictions made. TMIS is accessible by telephone dial-up and over the ARPANET.

16879 (UCRL—15324) Compression-molded energy-storage flywheels. Kay, J.F. (Owens-Corning Fiberglas Corp., Granville, OH (USA). Technical Center). Oct 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

Structural sheet molding compound (SMC) consisting of chopped Glass fiber reinforcement has been used to fabricate energy storage flywheel discs which have the potential to store up to 25 W hr/lb (55 W hr/kg). The discs, 21 in. in dia and up to one-inch thick, were compression molded using E glass and S-2 glass reinforcement chopped to either one or two inches in length in a polyester matrix. In the molding of the one-inch thick parts, a proprietary Owens-Corning Fiberglas Corporation (OCF) molding process was used to preclude the formation of gross internal defects due to entrapped exotherm heat of reaction and nonisothermal curing conditions.

2506 Thermal

REFER ALSO TO CITATION(S) 16724, 16725, 16726

16880 (ORNL/CSD/TM—145) Modeling of phase-change processes with time-varying critical temperature. Alexiades, V.; Solomon, A.D.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

We consider the posing of two-phase, one-dimensional, Stefan-like problems when the critical temperature of the phase change is not constant. Several combinations of variable densities, specific heats and critical temperature are considered. In all but the last case, when all three may vary, the interface condition has the usual form. However, in this last case the interface condition involves the whole history of the liquid.

2509 Batteries

REFER ALSO TO CITATION(S) 16666, 16667, 16672, 16673, 16673, 16788, 17063, 17065, 17068, 17071

16881 (EPRI-WS—79-192) Workshop on electrodes for flowing solution batteries. Summary report. Nanis, L. (SRI International, Menlo Park, CA (USA)). Feb 1981. 58p. (CONF-7911140—(Summ.)). NTIS, PC A04/MF A01.

From Workshop on electrodes for flowing solution batteries; Tampa, FL, USA (5 Nov 1979).

The electrochemical technology of aqueous secondary cells with flowing electrolyte solutions was the subject of a workshop sponsored by EPRI with the cooperation of DOE. The workshop was held in Tampa, Florida, 5-7 November 1979, and was attended by a select group drawn from advanced battery developers, government agencies, universities, and research organizations. The workshop general objectives were to look at the significant parameters believed to govern the performance of the two basic types of electrodes now in use; namely, a porous flow-through electrode (PFTE), and an impervious flow-by electrode. Progress, problems, and prospects were informally discussed. Brief critical reviews were given by session chairmen as a means of introducing each of the key topics (Current Distribution in FTPE, Conversion Efficiency, Segmented FTPE Studies, General Discussion on FTPF Parameters, Surface Activation, Application of FTPE to Waste Recovery, Exxon Zinc-Bromine Flow-By System, FTPE In NASA Redox Energy Storage, and Application of FTPE In Lockheed Zinc/Ferricyanide Redox System). The interaction of this diverse group of engineers and scientists was said by all to be of great benefit in widening understanding of the problems and possible future approaches to new work. The main needs for future work that were identified in the final discussion session among the participants were: (1) engineering analysis, (2) porous structures, (3) materials characteristics, and (4) chemical characteristics. In generally comparing flow-through to flow-by electrodes, there were some surprising differences arising from experimental results that did not fit conventional thinking.

16882 (SAND—80-7191) Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report. Clifford, J.E.; Brooman, E.W. (Battelle Columbus Labs., OH (USA)). Feb 1981. Contract AC04-76DP00789. 90p. NTIS, PC A05/MF A01.

The successful development of the nickel-hydrogen ($Ni-H_2$) battery for aerospace applications was reviewed to determine the potential applicability to terrestrial photovoltaic energy storage. The $Ni-H_2$ battery appears to have the best operational performance of any secondary battery for deep-discharge applications. There are several desirable technical characteristics of $Ni-H_2$ cells that have been demonstrated with aerospace cell designs that are of interest for terrestrial applications and photovoltaic energy storage in particular: long cycle life (> 7000 cycles) which has been demonstrated for aerospace cells at high depth of discharge of 80% of rated (theoretical) capacity at high rate of charge and discharge; the potential for long calendar life with minimal maintenance requirements; pressure indication of state-of-charge; and tolerance for overcharge, overdischarge, and operation at any state-of-charge. The relatively high rate of self-discharge of aerospace $Ni-H_2$ batteries might be minimized for terrestrial, stationary storage applications where weight and volume are less critical. The principal disadvantage is the high cost associated with present aerospace designs of the $Ni-H_2$ battery. From the preliminary design and cost assessment, it was tentatively concluded that further development could lead to projected costs that would be competitive with alternative battery systems. In view of the favorable technical performance, further study of the $Ni-H_2$ battery for terrestrial photovoltaic applications is recommended to determine the extent to which cost can be reduced without sacrificing performance.

16883 Electrochemically controlled charging circuit for storage batteries. Onstott, E.I. (to Dept. of Energy). US Patent Application 162,478. 24 Jun 1980. 13p.

An electrochemically controlled charging circuit for charging storage batteries is disclosed. The embodiments disclosed utilize dc amplification of battery control current to minimize total energy

expended for charging storage batteries to a preset voltage level. The circuits allow for selection of Zener diodes having a wide range of reference voltage levels. Also, the preset voltage level to which the storage batteries are charged can be varied over a wide range.

29 ENERGY PLANNING AND POLICY

16884 **(DOE/IR/05106—1) Primary urban energy-management-planning methodology.** (Public Technology, Inc., Washington, DC (USA)). Nov 1980. Contract FG02-78IR05106. 36p. NTIS, PC A03/MF A01.

Metropolitan Dade County, Florida, developed a pragmatic, transferable methodology to assist local governments in attempts to develop and implement energy management plans. A summary of that work is presented and suggestions are provided to guide the application and refinement of a Primary Urban Energy Management Planning Methodology. The methodology provides local governments with the systematic approach for dealing with short and intermediate-term urban energy management problems while at the same time laying the groundwork for the formulation of long-term energy management activities. The five tasks of the methodology summarized are: organizing for the PEP process; performing an energy use and supply inventory; formulating energy management goals and objectives; developing strategies to achieve the energy management objectives; and monitoring and evaluation. (MCW)

16885 **(DOE/SF/01963—T3) Summary of projects, small scale appropriate energy technology. Region IX program, 1979.** (Freebairn-Smith (Rod), Muir Beach, CA (USA)). 1979. Contract FG03-78SF01963. 24p. NTIS, PC A02/MF A01.

Summaries of the appropriate energy technology projects in Region IX are presented. The projects (over 100) are categorized into the following: house and building design; greenhouse systems; integrated systems; aquaculture; performance controls; hydroelectric; geothermal; food storage; biomass; wind and pumps; heat recovery and storage; solar space heating and cooling; cooling; and solar hot water. (MCW)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 16911, 16912, 16974, 16978, 17064, 17355

16886 **(EPRI-EA—1724) ETA-MACRO: a user's guide.** Manne, A.S. (Stanford Univ., CA (USA). Dept. of Operations Research). Feb 1981. 138p. NTIS, PC A07/MF A01.

The ETA-MACRO model is designed to estimate the extent of two-way linkage between the energy sector and the balance of the economy. It represents a merger between ETA (a process analysis for energy technology assessment) together with a macroeconomic growth model providing for substitution between capital, labor, and energy inputs. ETA-MACRO allows explicitly for (a) energy-economy interactions, (b) cost-effective conservation, (c) interfuel substitution, and (d) new supply technologies, each with its own difficulties and uncertainties on dates and rates of introduction. This user's guide includes an overview of the model, an illustrative application to long-term US energy projections, and technical descriptions of the macro and ETA submodels. It also includes an analysis of how market-penetration rates may be related to the profitability of new technologies. Finally, the appendices provide a detailed guide to the computer implementation.

16887 (LBL—11650, pp 1.1-1.56) **Energy Analysis Program.** Oct 1980.

In Energy and Environment Division annual report, 1979.

Progress in research on energy analysis is reported in 23 short reports: case for energy analysis; economic impacts of two energy projections; assessments of regional issues and impacts associated with national energy scenarios; evaluating air quality associated with future energy projections; institutional and political issues in power siting in California; integrated assessment for energy-related environmental standards; energy water issues; development of numerical methods for characterization of aquatic systems dissolved oxygen profiles; regional energy issues; workshop summary at LBL; national/regional energy-environment modeling concepts (workshop summary); critique of EIA energy scenario for region 9; energy analysis by means of computer generated interactive graphics; Hawaii integrated energy assessment; assessment of solar energy within a community: synopsis of three community-level studies; utility solar finance: economic and institutional analysis; local population impacts of geothermal energy development in Geysers-Calistoga KGRA; conservation strategies for community colleges; international residential energy conservation; overcoming social and institutional barriers to energy conservation; energy policy decisions and consumer decision making: application to residential energy conservation; use of DOE-2 to evaluate advanced energy conservation options for single-family residences; application of the ORNL residential energy demand model to the evaluation of residential energy performance standards; energy information validation. (MCW)

16888 **(LBL—11972) Energy Analysis Program, FY 1980.** (Lawrence Berkeley Lab., CA (USA)). Feb 1981. Contract W-7405-ENG-48. 102p. NTIS, PC A06/MF A01.

A separate abstract was prepared for each of the three general categories - Technology Assessments, Regional Studies, and Energy Efficiency Studies - in which the FY 1980 research is reported. (MCW)

16889 (LBL—11972, pp 1.2-1.3) **Technology assessments.** Ritschard, R.; Ghirardi, A. Feb 1981.

In Energy Analysis Program, FY 1980.

During FY 1980, studies dealing with technology assessment were covered in the following short reports: Biomass Conversion in Hawaii, R. Ritschard and A. Ghiradi; Marine Kelp (Energy Resources in the Coastal Zone), R. Ritschard and K. Haven; Economic Impacts of Energy Futures, J. Sathaye, H. Ruderman, and P. Chan; Organizational, Interface, and Financial Barriers to the Commercial Development of Community Energy Systems, R. Schladale and R. Ritschard; Commercialization of Solar Energy by Regulated Utilities, E. Kahn, P. Benenson, and B. Brown; Power System Reliability, D. Levy and E. Kahn; Acid Mine Drainage Impacts on Groundwater, M. Henriquez and J. Sathaye; Enhanced Oil Recovery, J. Sathaye and M. Milukas; and Geopressured Geothermal resources of the Texas and Louisiana Gulf Coast (A Technology Characterization and Environmental Assessment), A. Usibelli, P. Deibler, and J. Sathaye.

16890 **(ORNL—5754) Mathematical foundations of LEAP.** Oblow, E.M. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01.

As part of the ORNL energy model validation program an analysis was made of the mathematical structure of the LEAP energy modeling code. Emphasis was placed on understanding the equations which the code attempts to solve and the iterative numerical algorithm used to achieve a converged solution. The equations were found to be highly nonlinear, similar in form to those found in equilibrium boundary value problems. A combination of a standard nonlinear Gauss-Seidel approach and a modification of Newton's method was used as the basis of an iterative algorithm to find local solutions to the equilibrium equations. Several weaknesses in this approach are discussed, mainly those dealing with the computaton of relaxation coefficients in the Newton's method segment of the algorithm. The chief failing of the method as employed in LEAP is the use of a diagonal Jacobian matrix for Newton's method with an ad hoc scheme for calculating the diagonal matrix elements. Most problems encountered had large off-diagonal elements leading to a characteristic oscillatory break-down in convergence. It was concluded that the LEAP algorithm cannot be used to achieve convergence in an automated fashion for any general problem. In practice hand intervention is needed in most cases. Recommendations are made to approximate certain key elements of the Jacobian matrix to improve the general usefulness of the algorithm. Analytic expressions for the approximate elements are derived so as to facilitate implementation in LEAP. Other aspects of the numerical procedures are discussed, and recommendations for their improvement are also made.

16891 Input-output and energy demand models for the UK. Luxembourg; Commission of the European Communities (1980). 106p. (EUR—6769-EN). European Community Information Service, Washington, DC.

Procedures concerning the collection and processing of techno-economic data for the UK for the purpose of updating the EXPLOR input-output model of the UK and establishing an energy demand model for the UK are presented. The report is divided into two parts covering data for the EXPLOR model and data and illustrative results for the energy demand model. A complete file of data for EXPLOR-UK has been prepared. The data collection has been extended to include 1970, so as to ensure consistency with Eurostat accounting methods. A full set of data for 1970, 1974, 1980, and 1985 has been estimated and presented in the form required for EXPLOR in order to run the computer program for these years. The second major task constructs an energy demand submodel which takes as input the prices and quantities generated by EXPLOR-UK and uses these to forecast the transition matrix for nine energy products. This submodel is described in Part II and the associated Appendices. (MCW)

16892 Energy data handbook (Damocles). Part I: definitions and instructions. Heirwegh, T.; Jadot, P. Luxembourg; Commission of the European Communities (1980). 222p. (EUR—6779-EN(Vol.1)). European Community Information Service, Washington, DC.

The Energy Data Handbook describes the basic concepts for the representation of multinational Reference Energy System for the EC countries. The Energy Data Handbook is divided into two parts: Part I contains the theoretical description of the model concepts and definitions. It outlines the principles of the network representation. In this representation, each process of energy transformation is represented by a link. The links are identified by a keyword string defining in itself the process. Links are interconnected through modes which represent a particular energy form. Each process is numerically defined by a set of coefficients: technological parameters, cost data, capacity data, policy variables, and environmental or social factors. The coefficients are given in a time-series form allowing for energy studies on past as well as future years. Definitions of those parameters are given in Part I as well as instructions to fill up the data base.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 16457, 16492, 16493, 16494, 16495, 16496, 16497, 16504, 16629, 16886, 16920, 16933, 17364, 17365, 17367, 17372, 17393, 17394, 17447

16893 (BNL—28956) Impact of energy and environmental legislation on industry: problems of regulatory cost assessment. Meier, P.; Brown, S. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). 1980. Contract AC02-76CH00016. 45p. (CONF-800802—26). NTIS, PC A03/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

An examination is made of some of the problems of environmental impact assessment in the industrial sector, with particular attention to some important methodological problems frequently ignored. Some general problems of impact analysis are addressed in Section 2. This is followed in Section 3 by an overview of these major issues: the level of import substitutions, capital expenditures on pollution control, and a brief examination at how the industrial sector responded to post embargo energy price changes. Section 4 investigates marketplace responses to changes in manufacturing costs induced by regulatory requirements, from a general, theoretical microeconomics perspective. How industry responses can be estimated quantitatively for practical assessment purposes is taken up in Section 5, with a focus on the advantages and limitations of the two major modeling approaches (econometric and process models). These models allow investigations of the effects of different policies. (MCW)

16894 (DOE/PE/70106—T5) Problems of minority fuel-oil dealers. Kalt, J.P.; Lee, H. (Harvard Univ., Cambridge, MA (USA). Energy and Environmental Policy Center). 1980. Contract AM01-79PE70106. 34p. NTIS, PC A03/MF A01.

Claims that minority fuel oil dealers are hampered by severe impediments in the competition for contracts for oil, loan funds from banks, and assistance from the Federal government are explored. Possible remedial actions are recommended. The study focused on the metropolitan areas of Boston, Providence, and New York City. Following the introductory section, the evolving role of minority oil retailers in the Northeast market is reviewed in the second section. The third section examines the specific problems confronting minority dealers, including obtaining start-up capital and finding sources of supply. The fourth section addresses the problems associated with serving the inner-city markets. The fifth section introduces specific recommendations to meet the problems outlined.

16895 (JPRS—77198) China report: economic affairs, No. 110. (Joint Publications Research Service, Arlington, VA (USA)). 19 Jan 1981. Translation of various articles. 63p. NTIS.

Recent articles or announcements from China dealing with national economic policies and issues, finance and banking, petroleum and coal resources, and foreign and domestic trade are translated into English. (LCL)

16896 Impact of regulation on industrial innovation. Grabowski, H.G.; Vernon, J.M. Washington, DC; National Academy of Sciences (1979). 76p. (CONF-7805220—). National Academy of Engineering, Office of the Foreign Secretary, Washington, DC.

From Workshop on the Impact of Federal Regulations on Industrial Innovations; New York, NY, USA (2 May 1978).

This monograph presents an examination of the impact of US regulatory activities on technological innovation and it addresses the question of how these activities might be modified to lessen any negative effects of this kind without significant loss of benefits flowing from the regulation. It does not in any sense attempt to weigh the pros and cons of regulation, nor does it seek to render any value judgments whatsoever on possible benefits of regulation. It starts with the premise that we are committed to regulation and that it is sensible to do it as well as possible. One aspect of regulation that has been widely criticized and which has received too little attention in setting regulatory policy, action, and mechanisms is the effect of regulation on innovation. To examine this with the purpose of exploring ways to reduce possible negative effects on innovation, without loss of benefits, is not to attack regulation per se. Quite the contrary - if the regulatory process can be improved, it can only strengthen the case for regulation.

16897 INCHEM Tokyo 79. Tokyo, JP; Tokyo Electric Power Co., Inc. (1979). 99p. (CONF-7910208—(Absts)).

From International conference on energy conservation-utilization of urban waste heat; Tokyo, Japan (1 Oct 1979).

Papers delivered at the International Forum INCHEM Tokyo 79 are presented in 7 sessions. Session subjects and individual papers presented are: Is Japan's Market Closed; How to Approach the Japanese Market; Current Situation of Industrial Plant Trade and Its Role in the World Trade; The Situation and Role of Industrial Plant Trade in Korea; A Future Outlook of the Industrial Plant Trade; International Consortium to Promote Industrial Plant Trade; The Reasons for and Future Significance of an International Consortium; Technology Cooperation with Southeast Asian Countries; Chemical Technology for Environmental Preservation; International Aspects of Environmental Problems; Concept for Environmental Conservation and Recycling System of Wastes; The Future of Energy Demand, Supply and Technical Development for New Energy; Nuclear Energy and the Role of New Technologies; Development of High Temperature Gas Turbine-Steam Turbine Combined Cycle Plant for Community Cogenerating Energy System; IEA Policies for Energy Conservation Technology Development; Combined Heat and Power Generation for Community in Europe Generally and in Denmark Particularly; Public Acceptance of Technology. The lists of exhibitors at the Engineering Exhibition and the Plant Maintenance Show are presented. (MCW)

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 16499, 16635, 16636, 16893, 16969, 17389, 17424, 17448, 17452

2904 Natural Resources

REFER ALSO TO CITATION(S) 16980

16898 **(PB—80-210180) Changes in public land management required to achieve Congressional expectations. Executive summary. Report to the Congress.** (General Accounting Office, Washington, DC (USA). Community and Economic Development Div.). 16 Jul 1980. 45p. NTIS, PC A03/MF A01.

Public land managers in the Departments of Agriculture and the Interior are having difficulty achieving congressional expectations of producing the natural resources the Nation needs--timber, grazing forage, minerals, energy, etc.--while protecting the environment and conserving sufficient resources for the future. GAO recommends legislative and administrative changes which, together with agency actions already underway, should lead to (1) realistic assessments of resource supplies and demands; (2) resource production goals consistent with production capabilities and conservation and environmental restrictions; (3) better resource inventories and forest and rangeland management plans; (4) effective links between land management plans and annual budgets; (5) stronger and more effective programs for regulating public land users and maintaining facilities and resources; and (6) a proper balance between the agencies' land management responsibilities and capabilities.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 16390, 16459, 16512, 16887, 16888, 16889, 16925, 16939, 17076

16899 **(ANL/EES-TM—127) Application of a methodology for evaluation of intertechnology tradeoffs: an illustrative case study.** Whitfield, R.G.; Buehring, W.A.; Jusko, M.J.; Wolsko, T.D. (Argonne National Lab., IL (USA)). Nov 1980. Contract W-31-109-ENG-38. 49p. NTIS, PC A03/MF A01.

The problem is to select the best R and D strategy for developing long-term energy technologies that use coal. Best is defined in terms of 11 attributes, or measures of performance. Uncertainties were determined for the many, complex outcomes that may result from each strategy, and the information was systematically structured for evaluation. Preferences for the various outcomes were quantified by assessing a multi-attribute utility function over the 11 single attributes. The best alternative was chosen using maximization of expected utility as a guide. Extensive sensitivity analyses showed that one strategy, evolutionary development, was best over a wide range of plausible assumptions. This is partly because the alternative coal technologies are quite similar. However, the insights gained justify the extra effort spent in doing the utility analysis.

16900 (CONF-800483—(Vol.2), pp 747-753) **Energy research, development, and demonstration.** Ray, R.R. Jr. (Texas Energy and Natural Resources Advisory Council, Austin). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The Energy Analysis and Development Division of the Texas Energy and Natural Resources Advisory Council (TENRAC) has the following responsibilities specifically related to R, D, and D: (1) recommend legislation to the Council to foster the development of increased energy supplies and more-efficient energy systems not inconsistent with other laws of the state; (2) administer the Texas Energy Development Fund as directed by the Council; (3) maintain an awareness of all energy-related research of importance to this state in order to promote information exchange and coordination and in order to coordinate and support necessary energy-technology R, D, and D; and (4) coordinate and support energy-related technology R, D, and D. The rules adopted by TENRAC for administering development grants establish the following funding criteria for project selection: (1) specific to Texas, (2) near-term significance, (3) supported by matching funds, (4) not redundant, and (5) related to energy supply and conservation technology R, D, and D. Proposals are solicited by issuance of statements of program intent. Each proposal is evaluated by at least four technical experts outside the staff including, to the extent possible, representatives of the academic community, private industry, Federal government, and state government. TENRAC authorizes contract negotiations pursuant to staff recommendations based on the established evaluation process. Presentation includes up-to-date description of results of the solicitations, evaluations, recommendations, and contract awards.

16901 **(DOE/ER/10004—3) Management and use of DOE-provided discretionary funds. Progress report, January-December 1980.** (Illinois Univ., Urbana (USA). Office of Energy Research). Mar 1981. Contract AS02-78ER10004. 45p. NTIS, PC A03/MF A01.

The first section of this report presents brief summaries of the final reports for each Univ. of Illinois/Office of Energy Research project support by DOE in 1980, namely: An Assessment of the Impact of Commission Regulation on Prices; Radiative Collision Lasers; NO/sub x/ Decomposition in a Catalytic Muffler; Fuel/Air Control System for Catalytic Combustion Driven Stirling Engines - A Feasibility Study; Regional Environmental-Economic Optimization Models for Evaluating Policies Which Affect the Development of the Electric Power Industry in the Midwest; Analysis of Public Attitudes on Nuclear Power; Impacts of Energy Shortages Upon East Urbana, 1980: a Re-Study and Analysis; Alcohol energy Systems for Corn Farms; Feasibility of Greenhouses Heated with Surface Application of Power Plant Cooling Water; and Replacement of Petroleum Fuels with Alcohol. The second section deals with the proposed program for 1981 and use of the discretionary funds, specifically to encourage a distinguished multi-disciplinary group in Engineering Materials to direct their attention to the materials problems that are associated with advanced techniques of coal utilization, are described. A third section, Appendix A contains the complete program reports as submitted by the investigators. (MCW)

16902 **(DOE/ER/10125—1) Exploratory energy research program at the University of Michigan. Progress report.** Kerr, W. (Michigan Univ., Ann Arbor (USA)). 8 Dec 1980. Contract FG02-80ER10125. 15p. NTIS, PC A02/MF A01.

A DOE grant to the University of Michigan for an Exploratory Energy Research Program is being used by the U-M Office of Energy Research (OER) to support faculty research and graduate student research assistantships. Progress on activity during the first six months of the program is described and brief status reports on 20 energy-related faculty research projects in the physical, engineering, biological, and behavioral sciences are presented.

16903 **(DOE/SF/01963—T1) Summary of projects: small-scale Appropriate-Energy Technology Grants Program.** (USDOE Region IX, San Francisco, CA). 1980. Contract FG03-78SF01963. 32p. NTIS, PC A03/MF A01.

Summaries are briefly reported of over 180 projects in Region IX in the Appropriate Energy Technology Program. Broadly, the projects are categorized as follows: housing and building design; greenhouse systems; solar in industrial and agricultural applications; solar water heating; solar cooling and heating; heat storage; food preparation; wind; biomass (alcohol fuels, methane gas, combustion); hydroelectric power; integrated systems; and education and workshops. (MCW)

16904 (LBL—11972, pp 1.26-1.28) **Regional studies.** Ruderman, H.; Leung, P. Feb 1981.

In Energy Analysis Program, FY 1980.

During FY 1980, regional studies dealt primarily with analyzing the major environmental, socioeconomic, and institutional issues resulting from the Second National Energy Plan from renewable energy resource development in Hawaii, and from energy-related activities in the coastal zone of the West Coast of the US.

Subjects covered are: Forecasting Energy Demand for Hawaii, R. Ruderman and P. Leung; Forecasting the Role of Renewables in Hawaii, J. Sathaye and H. Ruderman; Coastal Zone Assessment Program, R. T. Ritchard and K. Haven; A Summary of Regional Impacts Associated with the Second National Energy Plan, R. Sextro, V. Berg, T. Chapman, M. El Gasseir, P. Podvin, H. Ruderman, J. Sathaye, S. Schaffer, and K. Tsao; Evaluating Land Use and Ecological Issues Associated with Future Energy Projections, V. Berg; Air Quality Constraints on Implementing the National Energy Plan in Federal Region IX, T. Chapman and R. Sextro; Water Availability and Quality Considerations Affecting Energy Futures in Federal Regional IX, M. El Gasseir; and Urban and Community Impact Analysis, H. Ruderman, F. Fung, and R. Beran.

16905 (LBL—11972, pp 1.49-1.53) **Energy efficiency studies: building energy performance standards for residential buildings.** Levine, M.; Goldstein, D.; Ingersoll, J.; Mass, J. Feb 1981.

In Energy Analysis Program, FY 1980.

A series of energy efficiency studies undertaken in FY 1980 include the following subjects: Building Energy Performance Standards for Residential Buildings, M. Levine, D. Goldstein, J. Ingersoll, and J. Mass; Determinants of Residential Energy Use, P. Craig, J. Cramer, K. Dake, T. Dietz, B. Gackett, D. Lowalezyk, M. Levine, and E. Vine; Life-Cycle Cost Analysis of Commercial Buildings, I. Turiel and M. Levine; Implementing Building Energy Standards in California, R. Feinbaum; Economic Benefits and Energy Savings of Appliance Efficiency Standards, M. McMahon and M. Levine; Life-cycle Cost Analysis of Major Appliances, I. Turiel, H. Estrada, and M. Levine; A Comparison of Regional and National Energy Efficiency Standards for Room and Central Air Conditioners, I. Turiel; New Data Applicable to the ORNL Residential Energy Demand Model, H. Herring; Assessment of Energy Demand Models, D. Freedman, T. Rothenberg, and R. Sutch; Energy Demand and Conservation in Kenya (Initial Appraisal), L. Schipper and J. Hollander; and International Residential Energy Conservation, L. Schipper and A. Ketoff.

16906 (UCID—18890) **Review of methods for evaluating R and D.** Feller, K.G. (Lawrence Livermore National Lab., CA (USA)). 14 Nov 1980. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

Methods are reviewed of R and D evaluation from the literature (in the industrial R and D setting and those proposed specifically for Federal R and D programs) relative to the types of R and D evaluation problems faced by DOE's Office of Advanced Conservation Technologies. Section 2 presents the general findings on the methods from the open literature, and recommendations on the types of analysis which are more likely to make a useful contribution to the R and D management process. Section 3 considers specific methods by briefly summarizing their approaches to particular types of R and D evaluation problems. Section 3.1 presents R and D evaluation methods which primarily address the R and D process. Section 3.2 is brief in comparison presenting some approaches which consider the eventual impact of the products of R and D. Section 4 examines the portfolio problem in particular, i.e., the problem of allocating resources over several program elements which support related technologies. The assumptions which underlie most methods of portfolio analysis in the literature do not apply to many government-managed R and D portfolios. (MCW)

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 16532, 16560, 16576, 17829, 17840

16907 **International cooperation in nuclear energy.** Yager, J.A.; Mabry, R.T. Jr. Washington, DC; Brookings Institution (1981). 236p. (DOE/TIC—11438).

This study reviews a broad range of international cooperative measures to control the development of nuclear energy. Discussed are: trends in civil nuclear energy; improving the present international nuclear regime; IAEA safeguards and the nonproliferation treaty; assurance of nuclear fuel supplies; the back end of the fuel cycle; new institutional arrangements; achieving new forms of cooperation; the present international regime; export policies of the major suppliers; and a summary of the Bellagio Conference.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 16878, 17064, 17067, 17071, 17072, 17073, 17074

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 17006, 17007, 17008, 17009, 17041, 17042, 17044, 17045, 17046, 17047, 17049, 17050, 17051

2910 Conservation

REFER ALSO TO CITATION(S) 16918, 16956, 16959, 16962, 16963, 16969, 16976, 16985, 16987, 16988, 17019, 17020, 17021, 17022, 17023, 17024, 17027, 17029, 17030, 17031, 17040, 17044, 17045, 17053, 17054, 17055

16908 **(PB—80-813785) Energy conservation: policies, programs, and general studies. 1964-1978 (citations from the NTIS data base). Report for 1964-78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 249p. NTIS PC N01/MF N01.

Abstracts pertaining to national policies, programs, and general studies of ways to conserve energy are presented. Topic areas cover such subjects as electric load management, effects of price and taxation on energy conservation, public attitudes and behavior toward energy saving, energy savings through reduction in hot water consumption, and telecommunications substitutability for travel. (This updated bibliography contains 240 citations, none of which are new entries to the previous edition.)

16909 **(PB—80-813793) Energy conservation: policies, programs, and general studies. 1979-July 1980 (citations from the ntis data base). Report for 1979-July 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 143p. NTIS PC N01/MF N01.

Abstracts pertaining to national policies, programs, and general studies of ways to conserve energy are presented. Topic areas cover such subjects as electric load management, effects of price and taxation on energy conservation, public attitudes and behavior toware energy saving, energy savings through reduction in hot water consumption, and telecommunications substitutability for travel. (This updated bibliography contains 138 citations, 95 of which are new entries to the previous edition.)

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 16886, 16891, 16892, 16922, 16938

16910 **(EPRI-EL—1758) Automatic load forecasting. Final report.** Nelson, D.J.; Vemuri, S. (Nebraska Univ., Lincoln (USA). Dept. of Electrical Engineering). Mar 1981. 62p. NTIS, PC A04/MF A01.

A method which lends itself to on-line forecasting of hourly electric loads is presented and the results of its use are compared to models developed using the Box-Jenkins method. The method consists of processing the historical hourly loads with a sequential least-squares estimator to identify a finite order autoregressive model which in turn is used to obtain a parsimonious autoregressive-moving average model. A procedure is also defined for incorporating temperature as a variable to improve forecasts where loads are temperature dependent. The method presented has several advantages in comparison to the Box-Jenkins method including much less human intervention and improved model identification. The method has been tested using three-hourly data from the Lincoln Electric System, Lincoln, Nebraska. In the exhaustive analyses performed on this data base this method produced significantly better results than the Box-Jenkins method. The method also proved to be more robust in that greater confidence could be placed in the accuracy of models based upon the various measures available at the identification stage.

16911 **(ORNL/CON—40) Commercial-energy-use model for the ten US Federal regions.** Cohn, S.M.; Corum, K.R.; Kurish, J.; Emerson, C. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 70p. NTIS, PC A04/MF A01.

Development of a regional forecasting tool for energy demand in the commercial sector of the US is described. Data bases for each of the ten Federal regions are developed as input to the ORNL commercial energy-demand model to evaluate conservation policies, new technologies, and fuel-price strategies on a regional basis from 1970 to 2000. Commercial-floor-space econometric models for each of ten commercial building types in each of the ten Federal regions are estimated to forecast the growth of energy using capital on a regional basis. In addition, regional energy-use indices (Btu/ft^2) are calculated using revised commercial energy-use and floor-space estimates. Comparisons are made between the commercial-floor-space forecasts of the regional models and the national commercial-energy-use model. In addition, validation of the forecasting accuracy of the regional models is made for a historical period. All regions show fuel switching away from fuel oil and natural gas to electricity. Regions 4, 6, and 10 (Southeastern, Southwestern, and Lower Western States) show the largest growth rates of projected primary energy consumption for the ten Federal regions with the Great Lakes states the lowest.

16912 **Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands.** Mischke, H.; Puetzstueck, H.; Bienewitz, K.H. Luxembourg; Commission of the European Communities (1980). 194p. (EUR—6774-EN).

The input-output and energy-demand modules of the medium-term EC Energy Model make an important contribution to the overall system. The general purpose is to obtain information on the economic activity and the energy consumption according to products on a sectoral basis. The input-output modules selected by the EC to be used in this context are the EXPLOR models established by the Battelle organization. EXPLOR models exist for all EC member countries, with the exception of Denmark and Ireland. The general advantage of using EXPLOR is to have a common methodology for all national models at input-output model level. The input-output model provides projections for about 35 sectors of the national economies of the EC member countries for the years 1980 and 1985. The present report deals with the execution by Battelle of the tasks concerning updating the EXPLOR models for the Federal Republic of Germany, Belgium/Luxembourg, and the Netherlands; establishing of Energy Demand Models for the above countries; and collecting the data for the Reference Energy System for the Federal Republic of Germany. (MCW)

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 16900, 16907, 16908, 16909, 16920, 16921, 16969, 17027, 17386, 17392, 17394

16913 **(DOE/RG—0057) Powerplant and Industrial Fuel Use Act annual report.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 1 Mar 1981. 50p. NTIS, PC A03/MF A01.

This annual report was prepared for the Congress by the Secretary of the Department of Energy (DOE) in conjunction with the Acting Administrator of the Environmental Protection Agency (EPA) as required by Section 806 of the Powerplant and Industrial Fuel Use Act of 1978 (FUA), Public Law 95-620, enacted November 9, 1978. This annual report describes actions taken under the legislation, which was enacted to promote national energy self-sufficiency and encourage the use of the alternate energy resources in electric powerplants and major industrial fuel-burning installations (MFBI's) in the utility, industrial and Federal governmental sectors. Annual FUA implementation activities are discussed and legislative requirements are satisfied that the annual report discuss: actions taken under FUA and under Section 2 of the Energy Supply and Environmental Coordination Act of 1974 (ESECA) Public Law 93-319 during the preceding calendar year; and the effectiveness of the provisions of both laws in achieving their purposes.

16914 **(DOE/RG/10367—T2) Quarterly project status report, January-March 1981.** (Systems and Applied Sciences Corp., Riverdale, MD (USA)). 1981. Contract AC01-80RG10367. 11p. NTIS, PC A02/MF A01.

The Department of Energy's (DOE), Economic Regualtory Administration (ERA), Office of Utility Systems (OUS), Division of Rates and Energy Management (DREM), stated a requirement to report to Congress on determinations made by State regulatory authorities and nonregulated utilities regarding purposes of Titles I and III of the Public Regulatory Policies Act (PURPA) of 1978. Progress in providing support to ERA by assisting technically and administratively in implementing ERA's information data base to their user audience is reported. The activities in this program are related to: information acquisition/dissemination; information analysis and retrieval; information storage; and information maintenance.

16915 **(ORAU/IEA—25(1980)) Oak Ridge Associated Universities, Institute for Energy Analysis research report 1980.** (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). Oct 1980. Contract AC05-76OR00033. 33p. NTIS, PC A03/MF A01.

The Institute for Energy Analysis examines broad questions of energy policy in assessing policy and research and development options and analyzes alternative energy-supply and -demand projections from technical, economic, and social perspectives. The Institute focuses primarily on a national energy issues, but also concerns itself with regional and international energy questions and their implications for domestic energy problems. Activities of the Institute in the following areas are summarized: electricity and nuclear energy; energy and Federalism (the role of reliable data); environment and energy; carbon dioxide; international energy analysis; and geothermal resources in the Tennessee Valley region. Abstracts are presented for 1980 publications by researchers at the Institute in the following areas: biological risks from energy technologies; carbon dioxide studies; energy conservation and cost analysis; energy data and modeling studies; energy use and the economy; US and international; fossil energy studies; nuclear energy studies; and solar and decentralized energy systems. The research staff and support staff are listed.

16916 **(PB—80-208648) New York State science, engineering and technology program. Phase I. Final report.** (New York Energy Office, Albany (USA)). Feb 1980. 78p. NTIS, PC A05/MF A01.

This report describes New York State's Science, Engineering, and Technology (SSET) Program for developing, integrating, and utilizing science, engineering, and technology (SET) resources in formulating energy policy for the State. Three task reports analyze the functions and responsibilities of the State Energy Office (SEO) and its sister agency, the New York State Energy Research and Development Authority (NYSERDA) and their respective use of science and technology to grapple with the complexities of New York State's energy situation. A summation and update of the task reports is offered. It includes recommendations based upon New York's energy policy formulaton model. The report also describes the organization, master energy plan, and other mechanisms for SSET transfer used by SEO and NYSERDA.

16917 **(PB—80-223647) The administration of regulation: permit and licensing activities for water resource management in New York and New Jersey.** Zimmerman, R. (New York Univ., NY (USA). Public Policy Research Inst.). 30 Apr 1980. Contract DI-14-34-0001-8405. 234p. NTIS, PC A11/MF A01.

The administrative problems created by the use of permits and licenses as a means of managing the effects of man-made changes on the environment is addressed in this study. Emphasis is placed on the managerial and organizational processes that support the permitting process and the effectiveness of these organizational designs in dealing with both the public and private sectors. The study concentrates on the administrative problems in the heavily industrialized and populated areas of New York and New Jersey.

16918 **State government leadership: California as a model of sound energy practice. Executive summary .** Sacramento, CA; California Energy Commission (1980). 59p. (NP—25368).

The current status of California's energy programs is reported. The potential for future energy and dollar savings that can be achieved by carrying out their conservation programs are evaluated and additional legislative and program options for a stronger, more aggressive state government leadership role are recommended. A historical perspective of the comprehensive state program is presented. Specific options for maximum reduction in state facility energy use include: incentives to encourage state agency conservation efforts, required energy audits of state buildings and facilities, and mandatory energy conservation and management programs. (MCW)

16919 **Local government energy programs: status, opportunities, and recommendations for state support.** Sacramento, CA; California Energy Commission (1980). 56p. (NP—25369).

A summary is presented of existing local government energy programs in California and identifies opportunities for achieving greater self-sufficiency. It also identifies current state and Federal programs and policies which assist or restrict local government efforts, and recommends state actions to accelerate local energy initiatives. (MCW)

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 16344, 16347, 16390, 16419, 16420, 16447, 16452, 16452, 16457, 16458, 16459, 16460, 16492, 16492, 16493, 16493, 16494, 16494, 16495, 16495, 16496, 16496, 16497, 16497, 16499, 16504, 16504, 16505, 16512, 16899, 17037, 17363, 17364, 17447

16920 **(DOE/FE—0014) Statement submitted by Roger W.A. Legassie, Assistant Secretary (acting) for Fossil Energy, to the Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, US Senate March 23, 1981.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy). Mar 1981. 41p. NTIS, PC A03/MF A01.

The revised budget request for Fossil Energy for FY 1982 is explained. This budget reflects the present administration's philosophy of the Federal government's role in the field of energy. Proposals of specific actions to take in FY 1981 and 1982 in regard to program functions are outlined. Budget recommendations in the following program areas are present: coal mining research and development; underground mining; surface mining; coal preparation; coal liquefaction; coal gasification; in-situ gasification; advanced research and control technology; environmental control technology; combustion systems; heat engines and heat recovery; magnetohydrodynamics; enhanced oil recovery; advanced process technology; oil shale R and D; enhanced gas recovery; coal resource management; oil shale industrialization; and Federal leasing. The greatest cutbacks appear to be in the coal program. The least amount of change is in the petroleum enhanced recovery and advanced process technology programs. (DMC)

16921 **(DOE/FE—0015) Policy implications of a shift in Federal synthetic-fuel-demonstration responsibility.** LeGassie, R.W.A. (Department of Energy, Washington, DC (USA). Assistant Secretary for Fossil Energy). 26 Mar 1981. 12p. NTIS, PC A02/MF A01.

The President's intention to shift the focus of synthetic fuels demonstration activities from DOE to the Synthetic Fuels Corporation (SFC) is discussed. The Demonstration Plant Program is described. The realignment will impact the organization, activities and mandate of the SFC. It will also impact the continuity of demonstration program efforts presently underway. Present contractual agreements between the government and industrial participants in synfuel development are described. Differences between DOE and SFC in project selection criteria, funding, priorities and restrictions is outlined. Legislative changes are not required to shift the demonstration responsibility to the Synthetic Fuels Corporation. (DMC)

16922 **(DOE/RG/10333—T1) Motor gasoline allocation; adjustment and downward certification.** (First Harlem Management Corp., New York (USA)). 1980. Contract AC01-80RG10333. 6p. NTIS, PC A02/MF A01.

The results of a survey of 14 refiners, 8 state government agencies, 5 trade associations, 1 mid-level marketer and the Department of Justice on adjustment and downward certification of motor gasoline allocation are analyzed. Only 3 of 14 refiners favored downward certification. Ten urged limited downward certification. Those opposed to any downward certification included 6 government agencies, the trade associations, a reseller, and 1 refiner. Alternatives and comments are included.

16923 **(PB—80-209190) A report to: the President and the Congress, by the National Advisory Committee on Oceans and Atmosphere, annual report (6th) June 30, 1977.** (National Advisory Committee on Oceans and Atmosphere, Washington, DC (USA)). 30 Jun 1977. 113p. NTIS, PC A06/MF A01.

In its Sixth Annual Report, the National Advisory Committee on Oceans and Atmosphere urges a comprehensive, planned approach to the many and varied uses of the sea and examines ways to meet this need. Related subjects which this report also addresses are Law of the Sea and other approaches to international cooperation in marine and atmospheric activities, offshore oil and gas, ocean engineering and research, and educating the public in marine affairs. The report then turns to the Nation's air pollution monitoring program, to weather warnings and forecasts, and to preservation of historical weather and ocean records.

16924 **(PB—80-212723) National emissions data system (NEDS) fuel use report (1977). Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1980. 127p. NTIS, PC A07/MF A01.

This report summarizes annual estimates of total consumption of major fuels such as coal, fuel oil, natural gas, gasoline, and diesel fuel. Estimates of the consumption of a number of other comparatively minor fuels are also included. The data are distributed according to major categories of air pollutant emissions sources and are reported for the nation as a whole and for individual states, territories, and the District of Columbia.

16925 **(PB—80-219603) Basic Coal Sciences Project Advisory Committee report. Final report, October 1979-October 1980.** (Science Applications, Inc., McLean, VA (USA)). Jul 1980. Contract GRI-5014-361-0187. 108p. NTIS, PC A06/MF A01.

This report has been prepared for GRI as a basis for identifying areas of research for its Basic Coal Sciences research project area. The technical content and recommendations were developed through a series of five Advisory Committee meetings over a period of 6 months. The Advisory Committee was composed of nationally recognized research scientists from a variety of relevant disciplines. The primary recommendation of the committee was that GRI sponsor projects for the selection, preparation, and distribution of standard coal samples and short reaction time samples to provide a more uniform material for other basic research efforts. The need for these standardized coal samples has been widely recognized by scientists who have been involved in basic coal research.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 16592, 16598

2960 Electric Power

REFER ALSO TO CITATION(S) 16373, 16447, 16617, 16618, 16619, 16620, 16621, 16623, 16624, 16625, 16626, 16667, 16682, 16914, 16956

16926 **(BNL—51285) Approach to market-penetration analysis for advanced electric-power-generation technologies.** Lamontagne, J.; Love, P.; Queirolo, A. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Dec 1980. Contract AC02-76CH00016. 54p. NTIS, PC A04/MF A01.

If commercialization of new technologies is the primary objective of the Department of Energy's Research, Development and Demonstration (RD and D) programs, the ultimate measure of benefit from RD and D programs is the extent of commercial ac-

ceptance of the developed technologies. Uncertainty about barriers to commercialization - government policy, fuel supply, etc. - make the task of estimating this acceptance very difficult. However, given that decisions must be made regarding allocation of RD and D funds, the best information available, with due regard for uncertainty, should serve as input to these decisions. An approach is presented for quantifying the range of market potential for new technologies (specifically in the utility sector) based on historical information and known plans for the future.

16927 **(DOE/EIA—0095(79)) Inventory of power plants in the United States: December 1979.** Gilliam, L.R. (USDOE Energy Information Administration, Washington, DC. Electric Power Statistics Div.). 1980. 559p. NTIS, PC A24/MF A01.

This 1979 inventory of power plants provides a comprehensive list of existing, standby, out-of-service, retired and projected electric generating plants in the U.S. Arranged under the broad sections of existing, jointly owned and projected units, tabulated data on individual plants in each state are presented. These data include unit name, location, type, MW rating, primary fuel, alternative fuel, status, year built, and whether or not it is jointly owned. Jointly owned plants are separately identified as to the percent of ownership belonging to named owners. Projected plants have data on plant characteristics, current status and scheduled completion date. Summaries of the total number of each type of power plant in each state are also provided. (LCL)

16928 **(FERC—0050) Power pooling in the Northeast Region.** (USDOE Federal Energy Regulatory Commission, Washington, DC. Northeast Regional Task Force). Feb 1981. 143p. NTIS, PC A07/MF A01.

This report is one of five regional reports prepared by task forces as part of the Federal Energy Regulatory Commission (FERC) power pooling study. The purpose of the study is to examine the opportunities for conservation of energy, optimization in the efficiency of use of facilities and resources, and increased reliability through power pooling arrangements. The Northeast Region includes that part of the Northeast Power Coordination Council (NPCC) that lies within the United States and the Mid-Atlantic Area Council (MAAC), two of nine Regional Reliability Councils of the National Electric Reliability Council (NERC). The Northeast Region includes three of the most highly integrated power pools in the country: the New England Power Pool (NEPOOL) and the New York Power Pool (NYPP), which make up the United States portion of NPCC, and the Pennsylvania-New Jersey-Maryland Interconnection (PJM), which covers the same area as MAAC. The areas served by the members of these pools include New England, New York, New Jersey, Delaware, large sections of Pennsylvania and Maryland, a very small part of Virginia, and all of the District of Columbia. Information is presented on the characteristics and problems of coordinated electric power operations in the region. The purpose of the task forces was to assist in developing a regionally specific factual understanding of the development, status, problems, plans, benefits, costs, industry and regulatory views, and other significant aspects of power pooling in the region. (LCL)

16929 **(FERC—0052) Power pooling in the North Central Region.** (USDOE Federal Energy Regulatory Commission, Washington, DC. North Central Regional Task Force). Feb 1981. 248p. NTIS, PC A11/MF A01.

This report is one of five regional reports prepared by task forces as part of the Federal Energy Regulatory Commission (FERC) power pooling study. The purpose of the study is to examine the opportunities for conservation of energy, optimization in the efficiency of use of facilities and resources, and increased reliability through power pooling arrangements. The practices of electric utilities in the North Central Region are examined. These utilities serve all of the States of Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, North Dakota, Ohio, and Wisconsin and parts of Kentucky, Maryland, Missouri, Montana, Pennsylvania, South Dakota, Virginia, and West Virginia. Information is provided on the characteristics and problems of coordinated electric power operations in the region with the goal of providing regionally specific data which will assist in developing a factual understanding of the development, status, problems, plans, benefits, costs, industry and regulatory views, and other significant aspects of power pooling in the region. (LCL)

16930 **(FERC—0053) Power pooling in the South Central Region.** (USDOE Federal Energy Regulatory Commission, Washington, DC. South Central Regional Task Force). Feb 1981. 162p. NTIS, PC A08/MF A01.

This report is one of five regional reports prepared by task forces as part of the Federal Energy Regulatory Commission (FERC) power pooling study. The purpose of the study is to examine the opportunities for conservation of energy, optimization in the efficiency of use of facilities and resources, and increased reliability through power pooling arrangements. Information is provided on the characteristics and problems of coordinated electric power operations in the region with the goal of providing regionally specific data which will assist in developing a factual understanding of the development, status, problems, plans, benefits, costs, industry and regulatory views, and other significant aspects of power pooling in the region. (LCL)

16931 **(FERC—0054) Power pooling in the Western Region.** (USDOE Federal Energy Regulatory Commission, Washington, DC. Western Regional Task Force). Feb 1981. 233p. NTIS, PC A11/MF A01.

This report is one of five regional reports prepared by task forces as part of the Federal Energy Regulatory Commission (FERC) power pooling study. The purpose of the study is to examine the opportunities for conservation of energy, optimization in the efficiency of use of facilities and resources, and increased reliability through power pooling arrangements. The current status of power system coordination in the Western Region is examined. Electric utilities in the Western Region serve all of Arizona, California, Colorado, Idaho, Nevada, Oregon, Utah, Washington, and Wyoming, and parts of Montana, Nebraska, New Mexico, South Dakota, and Texas. Information is provided on the characteristics and problems of coordinated electric power operations in the region with the goal of providing regionally specific data which will assist in developing a factual understanding of the development, status, problems, plans, benefits, costs, industry and regulatory views, and other significant aspects of power pooling in the region. (LCL)

16932 **(HNEI—80-07) Pricing new energy inputs into electrical supply in Hawaii.** Kamins, R.M.; Suyderhoud, J.P.; Fujii, E.T. (Hawaii Univ., Manoa (USA). Hawaii Natural Energy Inst.). Nov 1980. 146p. Hawaii Natural Energy Institute, Honolulu, Hawaii.

The Hawaii Public Utilities Commission is now engaged in preparing regulations to implement Act 102 of the 1977 Hawaii State Legislature and the 1978 Federal Public Utility Regulatory Policies Act (PURPA). The US statute largely preempts the field and sets the framework for determining the price of alternate energy. Deadline for the imposition of the rules is March 1981. Two categories of alternate energy producers may qualify for coverage under PURPA., The first includes small power production facilities with less than 80 MW of capacity which generate electricity by converting energy from biomass sources (such as municipal garbage or wood chips) or are fueled by renewable resources, such as wind, geothermal, or ocean thermal energy. The second category is made up of cogenerators of electricity, which produce electrical energy as a by-product of a process which also produces steam or heat used in industry (e.g. heat from the burning of bagasse in sugar mills). PURPA and Act 102 favor generation of electricity by producers other than electric companies, but the utilities are not defenseless to resist the entrance of new producers. Their primary defense is to hold down costs, so lessening the inducement to potential suppliers. They have little control over energy costs while they remain heavily dependent on oil. This study shows how the new regulatory law will shape the price structure for alternative, indigenous energy sources used to generate electricity in Hawaii, and to consider the economic effects of the pricing policies required by that law. The focus is on the electric power industry. (MCW)

16933 (NP—22593) Electric utility rate design study: costs and benefits of load management to society. (Electric Power Research Inst., Palo Alto, CA (USA); Edison Electric Inst., New York (USA); American Public Power Association, Washington, DC; National Rural Electric Cooperative Association, Washington, DC (USA)). 15 Sep 1980. 162p. EPRI, Palo Alto, CA.

This report consists mainly of two parts: (1) Costs of Load Management to Society, by Gordian Associates, Inc., 711 Third Avenue, New York, NY 10017; and (2) Potential Societal Costs of Time-of-Use Pricing of Electricity, by Prof. John Diffenbach, Northeastern Univ., Boston, MA 02115, who critiques the Gordian report and summarizes a similar study by Boston College School of Management in order to relate the two. A review of these two parts will lead the reader to conclude that identifying all the potential social-cost factors of a given load-management option is extremely difficult. In considering the two reports, Prof. Diffenbach states that it is premature to seek a consensus on how to study the societal consequences, let alone agree on findings, ... Research needed to reduce the uncertainty and clarify the issue of social costs, however, cannot be completed prior to termination of the Rate Design Study (RDS). Nevertheless, RDS recommends that: (1) additional research be conducted on the issue; and (2) uncertainty about the extent and magnitude of social costs should not preclude systematic evaluation and implementation of load-management options.

16934 (NP—25348) Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options. (Gordian Associates, Inc., New York (USA)). 21 Apr 1980. 285p. EPRI, Palo Alto, CA.

A rigorous procedure for conducting a cost benefit analysis so that an optimal set of load management options can be selected from a group of potential options is presented. The procedure accounts for the interactions between the load management options themselves and between these options and supply management options. The procedure further accounts for the goals of the utility planning process and recognizes reliability, dispatch, maintenance, and financial constraints. The Executive Summary provides an overview of the cost/benefit methodology and important conclusions and results from its application. Section 2 provides a more detailed description of the methodology along with insights and guidelines to assist in its implementation. Section 3 describes the illustrative application of the methodology to Vepco and provides the results of calculations pertaining to Vepco which correspond to each step of the methodology. Appendices present descriptions of models used and additional helpful information. The EPRI Advisory Group IV comments on the Cost Benefit Methodology for Evaluation of Load Management Options by Gordian Associates is presented. (MCW)

16935 (PB—80-208978) Automatic and discretionary adjustment procedures for electric utility rates. Volume II. Final report. (Wilson (J.W.) and Associates, Inc., Washington, DC (USA)). Nov 1979. Contract NBS-5-35894. 75p. NTIS, PC A04/MF A01.

Volume II is the User's Guide to the computer software developed for analysis and computation of fuel adjustments calculated in accord with the three methods discussed in Volume I. The first section of this Volume is a discussion of the several factors that determine an electric utility's fuel cost, including a series of numerical examples. The second section is a precise description of the three designs for fuel adjustment procedures which were introduced in Volume I. This description includes illustrations based on the numerical examples presented in the first section. The third section contains the instructions for using the computer software developed in this report for calculating fuel adjustments.

16936 (PB—80-214273) Assessment of energy parks vs. dispersed electric power generating facilities. Final report, 15 July 1975-31 December 1976. McGowan, A. (Scientists' Inst. for Public Information, New York (USA)). 1976. 114p. NTIS, PC A06/MF A01.

This report examines and evaluates issues raised by the General Electric Company's study of energy centers. This analysis by the Scientists' Institute for Public Information concluded that there is no compelling need for, or advantage to, the development and construction of energy centers. This is contrary to the General Electric report. Major findings in this report include the following: (1) The four-unit sites being developed at present are the largest sites that should be developed. (2) Larger scale development may lead the energy industry and the government into political, social and economic problems of an almost intractable nature. (3) Energy centers, as a concept, and given current considerations, are not desirable for inclusion in a comprehensive energy policy for the United States. (4) Finally, there are some considerations, particularly concerning national security, which would indicate more favorable consideration of energy parks. Therefore, the concept should be studied further.

16937 Electricity tommorrow. 1981 final report, summary. Sacramento, CA; California Energy Commission (1981). 19p. (NP—25338).

The California Energy Commission presents the Commission's views on the critical issues for the electricity sector in California. The report includes the Commission's adopted level of electricity demand and its adopted policies and supply criteria. Together, these form the basis for planning and certification of electric generation and transmission facilities by the Energy Commission. It also includes estimates of the potential contributions of conservation and various conventional and alternative supply sources, critiquies of utility supply plans, and determinations of how much new capacity is required. Finally, the report presents policy recommendations for directing public and private investments into preferred energy options, for spreading the benefits and costs of these options broadly and fairly among California's citizens, and for removing remaining obstacles to the development of all acceptable energy sources.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 16918, 16924, 16955, 16959, 16975, 16976, 16977, 16985, 17029, 17038

16938 Energy balances of OECD countries, 1974/1978. Paris, France; International Energy Agency (1980). 193p. (In English and French). (NP—25366). OECD Publications and Information Center, Washington, DC.

Energy-balance sheets for 1974-1978 are presented for OECD total, OECD Europe, North America, EEC, IEA, and 24 OECD countries. Data are presented in tabular format for solid fuels, crude oil, petroleum products, natural gas, nuclear, hydro, geothermal, electricity. Information on each fuel type for each country included is: total energy requirements; total final consumption; total industry; transportation; other sectors; non-energy uses; electricity generated. (MCW)

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 16628, 16630, 16632, 16633, 16634, 16638, 16648, 16649, 16650, 16651, 16667, 16671, 16681, 16682, 16687, 16692, 16700, 16702, 16710, 16726, 16744, 16761, 16770, 16771, 16775, 16776, 16777, 16778, 16779, 16903, 17076

16939 New renewable energy technologies and products. *Commercial News USA ;* 1-12(Apr 1981).

Special Energy Issue.

This entire issue of Commercial News USA is devoted to the title subject and highlights new renewable energy products available for export that have been developed and manufactured by US companies. One main section is devoted to Technology Status and includes solar thermal; solar thermal power systems; biomass; photovoltaic; wind energy power generation; low-head hydro; and ocean energy systems. The other main section is New Products USA and includes air collectors and systems; flat plate liquid collectors and systems; concentrating collectors and systems; collector components; storage systems; fluid-transport systems; solar desalinization; passive products; ocean thermal energy conversion; wind energy systems; low-head hydro systems; photovoltaic products and systems; biomass systems; industrial process heat; energy efficiency/conservation; instrumentation; and educational and research aids. Shorter sections are devoted to US Government (and non-

Government) sponsored events overseas; trade events in the US; trade associations; licensing and investment proposals; trade and technical literature; additional listing of journals; selected US Government publications on renewable energy technologies; other sources of information; and glossary of key terms. Two articles prepared especially for this special issue of Commercial News USA were abstracted separately: one by Dr. David Christensen of the University of Alabama, Huntsville and the other by George P. Lewett, Office of Energy-Related Inventions/NBS.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 17624

16940 **(ANL/MHD—80-5) Technical support for open-cycle MHD program. Progress report, October-December 1979.** Doss, E.D. (ed.). (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 97p. NTIS, PC A05/MF A01.

The support program for open-cycle MHD at Argonne National Laboratory is developing the analytical tools needed to investigate the performance of the major components in the combined cycle MHD/steam power system. The analytical effort is centered on the primary components of the system that are unique to MHD and also on the integration of these analytical representations into a model of the entire power producing system. The present project activities include modeling of the combustor, MHD channel and diffuser, slag separator, radiant boiler and high-temperature air heater. In addition, these models are combined into a complete system model, which is, at present, capable of carrying out optimizations of the entire system relative to either thermodynamic efficiency or cost of electrical power. Progress is reported in detail.

16941 **(DOE/ET/12346—T1) Technical support for the scientific information exchange program between Polish People's Republic and US Department of Energy. Final report.** (Avco-Everett Research Lab., Inc., Everett, MA (USA)). 1980. Contract AC01-78ET12346. 16p. NTIS, PC A02/MF A01.

The overall objective of this cooperative Scientific Information Exchange Program is to determine the effects of certain operating parameters on the plasma generated by the 4 to 5 MW coal combustor in Swierk, Poland. These operating parameters included (1) coal type, (2) coal moisture content, (3) seed injection, (4) slag removal, (5) coal size distribution, (6) equivalence ratio and (7) NO/sub x/, CO and SO/sub x/ content in the exhaust gas. Results are reported. (WHK)

16942 **(DOE/ET/15529—9) MHD generator electrode development. Quarterly report, October-December 31, 1980.** Sadler, J.W.; Cadoff, L.H.; Dietrick, D.L. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Jan 1981. Contract AC01-79ET15529. 91p. NTIS, PC A05/MF A01.

This program is directed towards the engineering development of cold metallic electrodes which are alternatives to the use of platinum as an anode clad material for MHD generators. Results of continuing laboratory screening tests are presented. Improvements in the anode arc test methodology and test setup, which have resulted in improved reproducibility as well as test simplification, are discussed. Laboratory electrochemical corrosion testing has been initiated using aqueous and molten salts as the aggressive constituent in the electrolyte. Initial results from these tests are reported. On the basis of these test results, electrochemical corrosion tests using a molten salt are preferred. As a result of ongoing laboratory screening tests, acceptance criteria, which are interim in nature and are likely to change based on future test results have been defined for the anode arc and electrochemical corrosion tests. Reflecting the initial laboratory test results, a listing of candidate advanced alloys which should demonstrate improved corrosion resistance has been defined. Upon completion of WESTF modifications, facility checkout and activation operations have been initiated. Progress, as well as those difficulties which have been encountered, in completing WESTF activation is reported. Detailed engineering and test planning activities in support of WESTF tests are reported.

16943 **(DOE/ET/15611—1) Fluctuations in combustion-driven MHD generators.** Barton, J.P. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Aug 1980. Contract AC01-80ET15611. 414p. NTIS, PC A18/MF A01.

Results of an experimental and theoretical investigation of inherent fluctuations that occur within combustion-driven MHD generators are presented. The primary concern was to determine the presence and effects of axially-propagating, linear hydrodynamic traveling-waves of the magnetoacoustic and magnetoentropic types. The possible development of large fluctuations in high magnetic interaction MHD generators caused by hydrodynamic traveling-waves propagating with increasing amplitude was considered. Experimentally, time-resolved measurements of pressures, electrode currents, and internal differential voltages within a laboratory-scale, combustion-driven MHD generator facility were analyzed. A special probe-tube microphone provided a sensitive measurement of the pressure fluctuations within a combustion-driven MHD generator duct. The time-resolved measurements were analyzed in terms of statistical properties such as relative fluctuation levels, spectral-density functions, cross-correlation coefficients, and coherence and relative phase functions. The presence and subsequent electrical effects of axially-propagating acoustic and entropy waves were observed. At low mean fluid velocities during MHD generator operation with high current densities, 1.0 Amp/cm^2, and with applied magnetic field, 2.4 Tesla, fluctuations in the current-magnetic field interaction force caused by the electrical conductivity variations associated with the entropy waves resulted in a threefold increase in pressure fluctuation levels within the upstream part of the MHD duct. Hydrodynamic traveling-waves within an MHD duct were theoretically investigated by considering a first-order linearization analysis of the controlling, quasi-one dimensional fluid and electrical equations of an MHD generator. Comparisons between experimental results and a theoretical model were in qualitative agreement.

16944 **Ceramic component for electrodes.** Bates, J.; Marchant, D.D. (to Department of Energy). US Patent 4,229,322. 21 Oct 1980. Filed date 16 Nov 1978. vp.

PAT-APPL-961152.

A ceramic component suitable for preparing mhd generator electrodes having the compositional formula: Y/sub x/(MgCr/sub z/)Wal(1-w)O_3 where x = 0.9 to 1.05, y = 0.02 to 0.2, z = 0.8 to 1.05 and w = 1.0 to the component is resistant to the formation of hydration products in an MHD environment, has good electrical conductivity and exhibits a lower electrochemical corrosion rate than do comparable compositions of lanthanum chromite.

3004 Thermionic Converters

16945 **(DOE/ET/15422—6) Theoretical analysis of ARC constriction.** Stoenescu, M.L.; Brooks, A.W.; Smith, T.M. (ENCOTH Corp., Princeton, NJ (USA)). Dec 1980. Contract AC02-79ET15422. 60p. NTIS, PC A04/MF A01.

The physics of the thermionic converter is governed by strong electrode-plasma interactions (emissions surface scattering, charge exchange) and weak interactions (diffusion, radiation) at the maximum interelectrode plasma radius. The physical processes are thus mostly convective in thin sheaths in front of the electrodes and mostly diffusive and radiative in the plasma bulk. The physical boundaries are open boundaries to particle transfer (electrons emitted or absorbed by the electrodes, all particles diffusing through some maximum plasma radius) and to convective, conductive and radiative heat transfer. In a first approximation the thermionic converter may be described by a one-dimensional classical transport theory. The two-dimensional effects may be significant as a result of the sheath sensitivity to radial plasma variations and of the strong sheath-plasma coupling. The current-voltage characteristic of the converter is thus the result of an integrated current density over the collector area for which the boundary conditions at each r determine the regime (ignited/unignited) of the local current density. A current redistribution strongly weighted at small radii (arc constriction) limits the converter performance and opens questions

on constriction reduction possibilities. The questions addressed are the followng: (1) what are the main contributors to the loss of current at high voltage in the thermionic converter; and (2) is arc constriction observable theoretically and what are the conditions of its occurrence. The resulting theoretical problem is formulated and results are given. The converter electrical current is estimated directly from the electron and ion particle fluxes based on the spatial distribution of the electron/ion density n, temperatures T/sub e/, T/sub i/, electrical voltage V and on the knowledge of the transport coefficients. (WHK)

3005 Fuel Cells

REFER ALSO TO CITATION(S) 16672, 16881

16946 (ANL—80-67) Advanced fuel-cell development. Progress report, January-March 1980. Pierce, R.D.; Arons, R.M.; Fraioli, A.V.; Kucera, G.H.; Poeppel, R.B.; Sim, J.W.; Smith, J.L. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 36p. NTIS, PC A03/MF A01.

Research and development activities at Argonne National Laboratory (ANL) directed toward understanding and improving components of molten carbonate fuel cells and operation of 10-cm square cells are reported. The principal focus has been on the development of electrolyte structures ($LiAlO_2$ and Li_2CO_3-K_2CO_3) that have good electrolyte retention and mechanical properties as well as long-term stability. This effort included work on preparation of sintered $LiAlO_2$ as electrolyte support; spray drying was used successfully in the preparation of $LiAlO_2$ powders for sintering. Several techniques are under study for preparing lithiated nickel oxide cathodes. Measurements were made of cell thickness changes during the heating and operation of two cells employing paste electrolyte structures. Cathode expansion during in-situ oxidation caused temporary leakage through both cathode and anode wet seals. The electrolyte pastes stiffened markedly soon after initial carbonate melting, but slow creep was observed for over 600 h with the cell under a compressive stress of 275 kPa.

16947 (BNL—29133) Zirconia fuel cells and electrolyzers. Isaacs, H.S. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 26p. (CONF-8006157—1). NTIS, PC A03/MF A01.

From 1. international conference on the science and technology of zirconia; Cleveland, OH, USA (16 Jun 1980).

A review of the historical development, operation, and problems of solid oxide electrolyte fuel cells and electrolyzers is given. The thermodynamic principles of operation are reviewed, and the overvoltage losses during operation of fuel cells and steam electrolyzers are discussed including physical factors and electrochemical factors. (WHK)

16948 (CONF-810315—8) Status of molten carbonate fuel cell technology. Marianowski, L.G.; O'Sullivan, J.B. (Institute of Gas Technology, Chicago, IL (USA)). 1981. 16p. NTIS, PC A02/MF A01.

From 8. energy technology conference and exposition; Washington, DC, USA (9 Mar 1981).

A molten carbonate fuel cell integrated with a coal gasification power plant is one of the most promising coal-using technologies because of its high efficiency, acceptable cost, and environmental acceptability. The high-temperature heat available from the fuel cell may be used in a bottoming cycle and/or industrial cogeneration applications. However, for the molten carbonate system to achieve these goals, continued developmental work is required which must take account of the operating conditions of the application. The progress made in improving cell performance and life and in producing inexpensive cell components is discussed. Performance is enhanced by alternate electrolytes and electrode compositions and increased pressures; life by control of contaminants, electrode-electrolyte behavior, and electrolyte loss; and cost by multicell stack designs and new means of fabricating components, the electrolyte tile, and substrate materials. The status, direction, and priority of future research and engineering efforts is also discussed.

16949 (DOE/ET/17089—T1) High-temperature, solid oxide electrolyte fuel cell power generation system. Quarterly report, June 1, 1980-August 31, 1980. Feduska, W.; Isenberg, A.O. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 1 Dec 1980. Contract AC02-80ET17089. 74p. NTIS, PC A04/MF A01.

Design and development progress is detailed. Porous support tube quality continues to improve, both through modification of extrusion equipment and through the use of pre-calcined, blended powder materials in the starting, batch material. Apparatus has been assembled and is operational to measure support tube gas diffusion and permeation coefficients. Candidate air electrode materials, having more stable physical and chemical properties, to replace tin-doped indium oxide, are being examined. Series-cell stack tests have been tested: (1) to establish the effect of vaiable-length cells in a stack on fuel utilization and performance, and (2) to evaluate the performance of a stack having a flame sprayed, air cathode. Results in both of these areas is very encouraging: 90% fuel utilization was obtained in the stack with variable cell length, and up to 1000 mA/cm^2 was obtained in the stack with a flame sprayed, doped lanthanum cobalt oxide cathode. The HTSOE fuel cell stack was found to be tolerant to 50 ppM H_2S in exit gas at 85% depletion (of CO/H_2 mixture), when operated at 150 mA/cm^2 for 800 h at 1000°C. Apparatus for AC and DC bench testing of stacks under variable fuel, oxidant, temperature conditions has been constructed and is operational.

16950 (EPRI-EM—1664) Stability of acid-fuel-cell cathode materials. Work period: January 1, 1978-December 31, 1979. Stonehart, P.; MacDonald, J.P. (Stonehart Associates, Inc., Madison, CT (USA)). Jan 1981. 65p. NTIS, PC A04/MF A01.

Results of a study on the stability of electrode materials used in hot phosphoric acid fuel cells are presented; the stability of the conductive carbon electrocatalyst support and the platinum-based electrocatalyst particles is studied. The effects of several parameters on specific corrosion rates of carbon substrates in hot phosphoric acid were investigated, and tests examined the loss of surface area of platinum supported on carbon under fuel cell operating conditions.

16951 (EPRI-EM—1699) Effects of sulfur-containing gases on the performance of molten carbonate fuel cells. Tang, T.E.; Claar, T.D.; Marianowski, L.G. (Institute of Gas Technology, Chicago, IL (USA)). Feb 1981. 48p. NTIS, PC A03/MF A01.

The effets of low-level (< 10 ppM) sulfur impurites as H_2S or COS in low-Btu fuel gas and as SO_2 in the oxidant gas were studied with 3-cm^2 molten carbonate fuel cells using standard components. Experiments were designed to study the cell performance responses to low-level sulfur excursions in fuel and/or oxidant that could occur during loss of cleanup capability of the sulfur removal subsytem. Results indicate that: (1) open circuit voltage (OCV) is not affected by low levels of sulfur, and all performance loss under current load occurs at the anode, even if sulfur is present as SO_2 in the oxidant; (2) for low-Btu fuel inlet compositions, a 10 mV loss per ppM H_2S at 160 mA/cm^2 can be expected, and higher performance losses will occur under anode outlet conditions (losses for COS were similar at 650°C); (3) the anode performance loss resulting from H_2S is smaller at temperatures higher than the normal 650°C operating temperature; (4) the performance loss resulting from SO_2 in the oxidant is more severe than that of the same level of H_2S in the fuel; and (5) performance losses are recovered after removal of sulfur from fuel or oxidant after exposures up to two weeks in duration.

16952 (EPRI-EM—1711) Stability of Kocite electrocatalysts in phosphoric acid fuels cells. Final report. Welsh, L.B.; Leyerle, R.W.; Scarlata, D.S.; Vanek, M.A. (UOP, Inc., Des Plaines, IL (USA)). Feb 1981. 67p. NTIS, PC A04/MF A01.

This report summarizes the results of a two-year program to characterize and improve the stability of Kocite electrocatalysts in phosphoric acid fuel cells. The experimental procedures, including the test conditions and analyses, are described. The electrocatalyst characterizations and test results are given for Kocite electrocata-

lysts tested in both compacted powder and PTFE-bonded electrodes.

16953 **(PB—80-813389) Fuel cells. 1977-1978 (citations from the NTIS data base). Report for 1977-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 198p. NTIS PC N01/MF N01.

This bibliography covers fuel cell applications, components, fabrication, design, catalysts, and chemistry. The citations discuss different types of fuel cells such as hydrogen-oxygen cells, hydrocarbon-air cells, and biochemical cells. (This updated bibliography contains 193 citations, none of which are new entries to the previous edition.)

16954 **(PB—80-813397) Fuel cells. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jul 1980. 144p. NTIS PC N01/MF N01.

Fuel cell applications, components, fabrication, design, catalysts, and chemistry are covered. The bibliography includes different types of fuel cells, such as hydrogen-oxygen cells, hydrocarbon-air cells, and biochemical cells. (This updated bibliography contains 139 citations, 97 of which are new entries to the previous edition.)

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 16939

16955 **(UCID—18991) California energy flow in 1979.** Briggs, C.K.; Borg, I.Y. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1981. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01.

Energy use in California during 1979 differed significantly from 1978. Overall use of natural gas in the state increased substantially (14.3%) due principally to greater use for electrical power production; 47% more gas was used for electrical power generation in 1979 than in 1978 and 21% more than in 1977. Use of fuel oil for electrical generation remained at the 1978 level but below the high 1977 level - which reflected substitution of oil for hydroelectric power during the 1976 to 1977 drought. Together, oil and gas accounted for 80% of the fuels used to generate electricity. Crude-oil imports principally from Indonesia fell substantially; however, use of Alaskan North Slope oil increased so that the net increase in crude oil use was up about 4%. The transportation end-use sector consumed about as much as in 1978 despite shortages in early 1979 associated with the Iranian revolution. While gasoline sales fell slightly, sales of high-sulfur residual oils (Bunker C) increased markedly. Transportation represents 38% of total energy consumption in California. The industrial climate remained robust as judged by energy consumption - up 12%. Nonetheless, fertilizer production in the state is falling due to higher natural gas prices. Firm customers in the residential, commercial, and firm industrial sectors registered modest increases in energy use reflecting in part the population increase.

3201 Buildings

REFER ALSO TO CITATION(S) 16698, 16918, 16994, 17023, 17043, 17355

16956 **(ANL/EES-TM—124) Energy savings attributable to switching from master metering to individual metering of electricity.** Nelson, S.H. (Argonne National Lab., IL (USA)). Jan 1981. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01.

This technical memo reviews and analyzes the published literature on electricity consumption by tenants in residential buildings with individual meters, compared with electricity consumption in residential buildings with master meters. An important finding is that energy savings of individual over master metering are strongly correlated with the price of electricity.

16957 (CONF-800483—(Vol.2), pp 448-458) **Computerized control of environmental systems.** Gatti, F.L. (Energy Accounting Systems, Inc., Macon, GA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

An examination is made of the actual implementation of two computerized environmental-system-maintainance control centers. Project A is a candy-manufacturing plant where controlled systems include subfreezing storage, HVAC, and cold storage (40F to 55F). Project B is a refrigerated warehouse where environments ranged from subzero (-10F) to battery chargers. Problems, solutions, hardware, and software are discussed.

16958 (CONF-800483—(Vol.2), pp 494-502) **Operating experience of a coal-fired fluidized bed at Georgetown, University.** Lutes, I.G.; Gamble, R.L. (Foster Wheeler Boiler Corp., Livingston, NJ). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Operation of the 100,000-lb/h capacity, coal-fired fluidized-bed steam generator at Georgetown University began in July 1979. The project involved expansion of the heating and cooling plant with this new coal-fired facility. Previously existing units at the university heating and cooling plant normally fire natural gas. The program demonstrates industrial and institutional application of fluidized-bed combustion using high-sulfur coal in an environmentally acceptable manner in a populated area. The unit has been successfully operated for over 1400 hours and in compliance with the strict emission regulations of Washington, DC. Operation on automatic control has been achieved and only minor operating difficulties have been experienced.

16959 **(DOE/EI/10416—1) Validation of thermal-energy-savings calculations in the SECP handbook. Final report.** Kennish, W.; Ganther, T.; Schatzberg, E.; Ahmed, M. (TPI, Inc., Beltsville, MD (USA)). 28 Nov 1980. Contract AC01-80EI10416. 203p. NTIS, PC A10/MF A01.

The validation study examines the assumptions of the State Energy Conservation Plan Handbook analysis procedure in order to determine the biases associated with each assumption. The introductory chapter contains a discussion of the SECP Handbook analysis methodology and situates the validation approach. The Validation Methodology chapter describes the validation methodology used in this study. The validation methodology consists of a detailed examination of the assumptions underlying the SECP Handbook, and of the biases associated with each assumption. The Conceptual Issues chapter discusses several basic problems which limit the accuracy of the SECP energy savings estimates. The chapter entitled Conventional Numbers presents a very detailed analysis of the methods and assumptions used to estimate the energy consumption of buildings constructed without a thermal efficiency standard. The chapter entitled 90-75 Values presents a similar anlysis of the numbers in the SECP Handbook which represent the energy consumption of buildings constructed using ASHRAE Standard 90-75. The State Correction Factor chapter analyzes the method used to adjust regional energy conservation estimates to individual states and demonstrates the state correction factors are one of the weakest links in the SECP evaluation methodology, especially with regard to commercial buildings. The Square Footage chapter discusses the errors associated with the estimates of new building construction contained in the SECP Handbook. Finally, the Conclusions and Recommendations chapter summarizes the biases associated with the assumptions and discusses the net effect of these biases.

16960 **(DOE/PE/70044—T2) Major models and data sources for residential and commercial sector energy conservation analysis. Final report.** (Hittman Associates, Inc., Columbia, MD (USA)). Sep 1980. Contract AC01-79PE70044. 175p. NTIS, PC A08/MF A01.

Major models and data sources are reviewed that can be used for energy-conservation analysis in the residential and commercial sectors to provide an introduction to the information that can or is available to DOE in order to further its efforts in analyzing and quantifying their policy and program requirements. Models and data sources examined in the residential sector are: ORNL Residential Energy Model; BECOM; NEPOOL; MATH/CHRDS;

NIECS; Energy Consumption Data Base: Household Sector; Patterns of Energy Use by Electrical Appliances Data Base; Annual Housing Survey; 1970 Census of Housing; AIA Research Corporation Data Base; RECS; Solar Market Development Model; and ORNL Buildings Energy Use Data Book. Models and data sources examined in the commercial sector are: ORNL Commercial Sector Model of Energy Demand; BECOM; NEPOOL; Energy Consumption Data Base: Commercial Sector; F.W. Dodge Data Base; NFIB Energy Report for Small Businesses; ADL Commercial Sector Energy Use Data Base; AIA Research Corporation Data Base; Nonresidential Buildings Surveys of Energy Consumption; General Electric Co: Commercial Sector Data Base; The BOMA Commercial Sector Data Base; The Tishman-Syska and Hennessy Data Base; The NEMA Commercial Sector Data Base; ORNL Buildings Energy Use Data Book; and Solar Market Development Model. Purpose; basis for model structure; policy variables and parameters; level of regional, sectoral, and fuels detail; outputs; input requirements; sources of data; computer accessibility and requirements; and a bibliography are provided for each model and data source.

16961 **(DOE/SF/10840—T1) Unified interzone and system coupling methodology for building energy analysis. Final report.** Sullivan, R.; Nozaki, S.; Cumali, Z.O. (CCB/CUMALI Associates, Oakland, CA (USA)). 16 Feb 1981. Contract AC03-80SF10840. 96p. NTIS, PC A05/MF A01.

The methodology used for analyzing interzone and system coupling phenomenon in building heat transfer processes is documented. A discussion is presented describing the current techniques employed by two public domain energy analysis simulation programs: DOE-1/2 (weighting factor) and BLAST (thermal balance). Although these programs perform their primary function quite well, the applicability of the methods to situations in which there exists strong coupling between the zones and systems in a building, is open to question. Particularly for passive solar design schemes, the approximations utilized would seem to be somewhat unreliable. Alternative coupling techniques are next discussed, which amounted to extensions of the basic algorithms involved to yield simultaneous solutions among the zones and systems. Both the weighting factor and thermal balance approaches are treated in addition to the concepts of radiosity and mean radiant temperature. The decision was made to utilize the modified thermal balance coding revisions to DOE-2.0 developed at LASL and LBL as a base for testing the techniques described. Modifications were therefore made to version DOE-2.1 such that four thermal load calculation schemes can now be studied: weighting factor, modified thermal balance, mean radiant temperature and radiosity. These techniques have been implemented for a fully coupled N-zone problem with system integration, to include the modeling of a Trombe wall algorithm.

16962 **(DOE/TIC—11436) Review of utility home-energy-audit programs.** Hirst, E.; Berry, L.; Soderstrom, J. (Oak Ridge National Lab., TN (USA)). Dec 1980. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01.

Evaluation efforts of utilities with active home-energy-audit programs were reviewed to provide insights into the operations and effectiveness of existing programs. About half the utilities contacted had little or no evaluation activity. Of those with evaluation activity, most conducted only informal evaluations for in-house use. A few utilities had conducted fully documented formal evaluations. On the basis mainly of written reports received from the utilities, findings about customer response to programs are summarized. The topics discussed include: determinants of program participation rates, use of financing, attitudes toward programs, actions taken, characteristics of participants, and energy savings due to programs.

16963 (LBL—11650, pp 2.1-2.84) **Energy efficient building programs.** Oct 1980.

In Energy and Environment Division annual report, 1979.

Progress in research on energy efficiency buildings at LBL is reported for the following programs: Building Envelopes Program; Building Ventilation and Indoor Air Quality Program (gas stove emissions, organic contaminants, radon measurements and emanation studies, indoor radon health risks, field monitoring of indoor air quality; mechanical ventilation systems using air-to-air heat exchangers; subcontract activities; ventilation-indoor air quality data base); DOE-2 computer program for building energy analysis; Hospitals Program; Energy Efficient Windows Program; Energy Efficient Lighting Program; conservation potentials: compilation, publication, and demonstration; summary and demonstration of potential savings in the buildings sector; evaluation of building energy performance standards for residential buildings; energy efficient standards for residential appliances including heating and cooling equipment; the impact of energy performance standards on the demand for peak electrical energy. (MCW)

16964 **(LBL—12280) Test results and methods: residential air-to-air heat exchangers for maintaining indoor air quality and saving money.** Fisk, W.J.; Roseme, G.D.; Hollowell, C.D. (Lawrence Berkeley Lab., CA (USA)). Feb 1981. Contract W-7405-ENG-48. 18p. (CONF-810423—4). NTIS, PC A02/MF A01.

From 1. International Energy Agency (IEA) conference on new energy conservation technologies and their commercialization; Berlin, F.R. Germany (6 Apr 1981).

LBL has constructed a facility for testing various performance aspects of residential air-to-air heat exchangers. When used in conjunction with a mechanical ventilation system, a residential heat exchanger permits the adequate ventilation of a residence while recovering most of the energy normally lost during ventilation. By constructing or retrofitting a home so that it has low natural infiltration rates and by using a heat exchanger-ventilation system, a homeowner can save energy, reduce heating and cooling costs, and prevent the buildup of indoor-generated air contaminants. Results obtained on five different residential heat exchangers are presented. The performance criteria and the test facility are described. The performance parameters measured were heat exchanger effectiveness (a measure of heat transfer ability), airstream static pressure drop, and fan system performance. The performance of the five heat exchangers differed greatly. The ability to transfer heat ranged from 43% to 75% of the theoretical maximum. The resistance to air flow varied by a factor of two. One of the heat exchangers was highly susceptible to leakage between airstreams and one had an unstable performance. In the future, additional heat exchangers will be tested, a new test system will be used to measure cross-stream leakage, and the possibility and consequences of freeze-up within the heat exchangers will be investigated.

16965 **(NBS-TN—1131) Field investigation of the performance of residential retrofit insulation.** Weidt, J.L.; Saxler, R.J.; Rossiter, W.J. Jr. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Sep 1980. 69p. GPO $3.75.

A study was conducted to obtain information on the performance of in-service insulations of the type commonly used in the US to retrofit side-walls of housing: urea-formaldehyde based foam, loose-fill cellulose, and loose-fill mineral fiber. In the field phase of the study, observations were made on performance-related factors such as: the completeness of filling the cavity, the condition of the insulation and wall components, and evidence of moisture accumulation such as water stains on sheathing, studs and other wall components. Shrinkage was observed to have occurred for all urea-formaldehyde based foam specimens. Where measurable, it was found to be within a range of 4 to 9%. For the six test houses containing loose-fill insulation which were opened at the top of the wall cavity, only one with cellulose contained a void of undetermined origin at that location. Insulation specimens removed from the walls were tested to determine their density, thermal resistivity, and moisture content. The pH and moisture absorption of the urea-formaldehyde based from specimens were also determined. Results of the laboratory measurements are discussed and compared with data from other studies. Relationships between the moisture contents of the samples and their thermal resistivities were not found. Results indicated that the retrofitting of the inspected sidewalls was for the most part accomplished without adverse effect upon them.

16966 **(ORNL/Sub—7715/2) Reduction in the thermal resistance (R-value) of loose-fill insulation and fiberglass batts due to compression.** Yarbrough, D.W.; Wright, J.H. (Tennessee Technological Univ., Cookeville (USA). Dept. of Chemical Engineering). Apr 1981. Contract W-7405-ENG-26. 84p. NTIS, PC A05/MF A01.

A method is presented for calculating the thickness reduction of loose-fill insulations and fiberglass batts that result from

compressive forces exerted by additional insulation. The thickness reduction is accompanied by an increase in density and a reduction in the R value of the compressed layer. Calculations for thermal resistance of two layers of insulation are given. Information in 4 appendices includes: identification of products tested (products from 3 companies); experimental values for thickness as a function of loading; Fortran programs and output; and calculated R values for stacked insulations. (MCW)

16967 **(ORNL/TM—7629) Roofing research: a bibliography.** Robinson, J.N.; Nichols, C.L. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 74p. NTIS, PC A04/MF A01.

A listing, indexed by subject, primary author, and secondary authors, is presented of some 530 references in the literature related to roofing research - materials, construction, and in-service problems. Structural design of roofing systems is not covered.

16968 **(P—400-80-069) Guide to the energy conservation regulations for new nonresidential buildings.** (California Energy Commission, Sacramento (USA)). Sep 1980. 121p. California Energy Commission, Sacramento.

Division 5 of the Energy Conservation Standards for new Nonresidential Buildings deals with Heating, Ventilation, and Air Conditioning Systems. These standards are aimed at providing acceptable comfort conditions while using as little new energy as possible. Information is presented to show designers, contractors, and environment agencies how to apply the HVAC systems standards for new nonresidential buildings. The five principal restrictions and specifications in the standards are detailed and information on: when the HVAC systems standards apply; load calculations; ventilation; room temperature control; restrictions on HVAC system types; when free cooling (economizer cycle) is required; duct insulation and construction requirements; fan power restrictions; piping insulation; and compliance forms and their use is presented. A sample problem on what to do if your design does not comply is shown. (MCW)

16969 **(P—700-80-013) Proposed residential building standards: draft environmental impact report.** (California Energy Commission, Sacramento (USA)). Mar 1981. 231p. California Energy Commission, Sacramento, CA.

The Warren-Alquist Act of 1974 requires the California Energy Commission to adopt and periodically update energy-conservation standards for new residential buildings. The Act also requires the CEC to adopt performance standards for new buildings. With increased energy costs, the CEC staff proposed to update the current energy-conservation standards and they are a hybrid of performance and prescriptive requirements. The proposed standards do not cover hotels, motels, or buildings over 3 stories high. The purpose of an environmental impact report (EIR) is to provide public agencies and the public in general with detailed information about the effects a proposed project is likely to have on the environment, to list ways in which the significant effects of such a project might be minimized, and to indicate alternatives to the project. The contents of this Draft EIR includes: a project description; a description of the environmental setting, impacts, and mitigation measures; a discussion of alternatives; and an indication of growth-inducing impacts. The Draft EIR discusses both environmental and socio-economic impacts of the proposed standards compared to both the current standards and the pre-1975 practices. (MCW)

16970 **(PB—80-210719) Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979.** DeWerth, D.W.; Loria, R.L. (American Gas Association Labs., Cleveland, OH). 15 Jan 1980. Contract GRI-5014-345-0116. 77p. NTIS, PC A05/MF A01.

Potential energy savings, and effect on performance were determined for four furnaces and two boilers when retrofitted with the following efficiency improvement techniques; (a) derate, (b) vent connector restrictor, (c) automatic vent damper, (d) thermal vent damper, (e) IID's, and (f) combinations of the above. Advance technology systems with high seasonal efficiency were studied (pulse combustion boiler, pulse combustion furnaces, power burner furnaces, power boilers) and the results are presented. Also discussed are the energy saving potential of two heat recovery devices for installation in the flue of gas-fired appliances.

16971 **(PB—80-210727) Improvements in appliance efficiency. Task II. Improvement of commercial cooking equipment. Annual report for 1979.** Himmel, R.L. (American Gas Association Labs., Cleveland, OH). Jan 1980. Contract GRI-5014-345-0116. 56p. NTIS, PC A04/MF A01.

This report discusses work on deep fat fryers, range oven sections, and range open top sections. Two new deep fat fryers were designed and constructed which have an efficiency improvement of 25 percent over conventional units, utilize less frying oil and have improved cleanability. They also differ from conventional units by their tank geometries and the fact that they employ infrared burners. A 45 percent improved range over section is described which was converted from natural convection to forced convection. Oven capacity heat distribution was also improved and the motor horsepower was significantly reduced from that used in normal practice. Initial modifications to range open top burner systems demonstrated a 17 percent reduction in fuel consumption with good combustion.

16972 **(PB—80-210735) Improvements in appliance efficiency. Task IV. Corrosive effects of condensate. Annual report for 1979.** DeWerth, D.W.; App, M.J. (American Gas Association Labs., Cleveland, OH). 22 Jan 1980. Contract GRI-5014-345-0116. 28p. NTIS, PC A03/MF A01.

The report describes the first year's effort of a procect aimed at evaluating the corrosive effects of condensate produced in high efficiency gas-fired appliances. Through review of the literature and discussion with utilities, 8 fuel gas compositions were identified as typifying near future pipeline quality gases. A special set-up was constructed to collect the condensate generated by burning the 8 gases. Suitable analyses methods were identified for measuring the NO_3, NO_2, SO_3, SO_4 and dissolved CO_2 in the condensate of the 8 gases.

16973 **(PB—80-213424) Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final).** Arens, E.A.; Flynn, L.E.; Nall, D.N.; Ruberg, K. (National Engineering Lab. (NBS), Washington, DC (USA)). Aug 1980. 124p. NTIS, PC A06/MF A01.

Two techniques are developed and tested for creating composite and synthetic hourly weather data for a wide range of sites. The first technique selects real weather data segments from a source multiyear weather record, and links them into a composite synthetic year, in which the hourly values are unchanged from the source. The second technique adjusts the real hourly data values of the source to create a more completely synthetic year. The techniques may be applied individually or in combination. The resulting synthetic year or years can be used to provide data that is representative of long-term climate for building energy prediction either at the first-order station where the source hourly weather data were recorded, or at a nearby second-order station for which only summarized climate averages are available. Additionally, the adjustment technique can generate synthetic data to represent specific time periods at second-order stations for use in energy audits and experiments. The effectiveness of extrapolating weather data from one location to another is assessed, and the uses of the two techniques are described. The user-interative Fortran programs, SELECT and ADJUST are appended.

16974 **(PB—80-213986) Simplified heating and cooling energy analysis calculations for residential applications.** Kusuda, T.; Saitoh, T. (National Engineering Lab. (NBS), Washington, DC (USA)). Jul 1980. 136p. NTIS, PC A07/MF A01.

In order to shorten the lengthy computational labor and cost common to most existing hourly simulation computer programs, a simplified energy calculation procedure was developed for the evaluation of energy conservation effectiveness of home retrofitting. The procedure utilizes monthly normal weather parameters such as temperature, humidity, wind data, and solar radiation, in lieu of the traditional degree-day procedure. The thermal time constant was used to account for the effect of building thermal mass on seasonal

heat transfer performance. In addition to standard retrofit procedures such as addition of thermal insulation, use of storm windows, and sealing of cracks, included in the procedure are the energy conservation effects due to the use of solar collectors, hot water tank insulation, and insulation around the heat distribution systems such as ducts and pipes.

16975 **(PB—80-222714) Lighting issues in the 1980's: summary and proceedings of a lighting roundtable held at New York, New York on June 14 and 15, 1979. Final report.** Rubin, A.I. (National Engineering Lab. (NBS), Washington, DC (USA)). Aug 1980. 178p. NTIS, PC A09/MF A01.

The Lighting Roundtable described in the report was conducted to foster an open discussion of the goals, issues, and responsibilities of the lighting community. It was not a problem-solving session, but rather a time to examine the long-term aspirations and objectives of lighting and barriers that may stand in the way of achieving them. Eight major issues were addressed by nine panelists and a number of invited auditors. The issues are as follows: (1) The Public Image of the Lighting Community; (2) U.S. Role in the Worldwide Lighting Community; (3) Factors Affecting Human Activities in the Built Environment; (4) Effect of Lighting on Environmental Quality; (5) Effects of Barriers; (6) Establishment of Illuminance Levels; (7) Integration of Subsystems; and (8) Professional Development and Lighting Education. The present publication consists of two parts: (1) A summary of the proceedings and (2) a complete transcript.

16976 **(PNL—3605) Regional variations in US residential-sector fuel prices: implications for development of building energy-performance standards.** Nieves, L.A.; Tawil, J.J.; Secrest, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1981. Contract AC06-76RL01830. 95p. NTIS, PC A05/MF A01.

The Notice of Proposed Rulemaking for Energy Performance Standards for New Buildings presented life-cycle-cost based energy budgets for single-family detached residences. These energy budgets varied with regional climatic conditions but were all based on projections of national average prices for gas, oil and electricity. The Notice of Proposed Rulemaking indicated that further analysis of the appropriateness of various price measures for use in setting the Standards was under way. This part of that ongoing analysis addresses the availability of fuel price projections, the variation in fuel prices and escalation rates across the US and the effects of aggregating city price data to the state, Region, or national level. The study only provides a portion of the information required to identify the best price aggregation level for developing of the standards. The research addresses some of the economic efficiency considerations necessary for design of a standard that affects heterogeneous regions. The first section discusses the effects of price variation among and within regions on the efficiency of resource allocation when a standard is imposed. Some evidence of the extreme variability in fuel prices across the US is presented. In the second section, time series, cross-sectional fuel price data are statistically analyzed to determine the similarity in mean fuel prices and price escalation rates when the data are treated at increasing levels of aggregation. The findings of this analysis are reported in the third section, while the appendices contain price distributions details. The last section reports the availability of price projections and discusses some EIA projections compared with actual prices.

16977 **(RAND/R—2515-DOE) Household energy use in non-OPEC developing countries.** Fernandez, J.C. (RAND Corp., Santa Monica, CA (USA)). May 1980. Contract AC01-79PE70078. 88p. NTIS, PC A05/MF A01.

Energy use in the residential sector in India, Brazil, Mexico, the Republic of Korea, the Sudan, Pakistan, Malaysia, and Guatemala is presented. Whenever possible, information is included on the commercial fuels (oil, gas, coal, and electricity) and on what are termed noncommercial fuels (firewood, animal dung, and crop residues). Of special interest are the differences in the consumption patterns of urban and rural areas, and of households at different income levels. Where the data allow, the effect of household size on energy consumption is discussed. Section II is an overview of the data for all eight countries. Section III examines those areas (India, Brazil, Mexico City) for which data exist on the actual quantity of energy consumed by households. Korea, the Sudan, and Pakistan, which collect data on household expenditures on fuels, are discussed in Section IV. The patterns of ownership of energy-using durables in Malaysia and Guatemala are discussed in Section V. (MCW)

16978 **(SERI/TP—721-1133) Overview of validation procedures for building energy-analysis simulation codes.** Wortman, D.; O'Doherty, B.; Judkoff, R. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1981. Contract AC02-77CH00178. 5p. (CONF-810509—12). NTIS, PC A02/MF A01.

From Annual conference of the International Solar Energy Society; Philadelphia, PA, USA (26 May 1981).

SERI is developing a procedure for the validation of Building Energy Analysis Simulation Codes (BEAS). These codes are being used increasingly in the building design process, both directly and as the basis for simplified design tools and guidelines. The importance of the validity of the BEAS in predicting building energy performance is obvious when one considers the money and energy which could be wasted by energy-inefficient designs. However, to date, little or no systematic effort has been made to ensure the validity of the various BEAS. The validation work at SERI consists of three distinct parts: Comparative Study, Analytical Verification, and Empirical Validation. The procedures have been developed for the first two parts, and these procedures have been implemented on a sampling of the major BEAS. Results from this work have shown major problems in two of the BEAS tested. Furthermore, when one building design was run on several of the BEAS, there were large differences in the predicted annual heating loads. The empirical validation procedure will be developed when high quality empirical data become available.

16979 **Combination central heat steam and heat pump installation. A comparison of a school with and without heat recovery.** Dwyer, P.B. (Detroit Edison Co., MI). pp 7, Section 17 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

The installation and operation of a loop system heating system which consists of many small-packaged water-to-air heat pumps is described. An uninsulated water pipe loop is installed around the perimeter of each floor of the building. In each zone or individual office, a cabinet containing a water source heat pump, air filter, blower, and control package, is installed. When the control calls for heat, the unit chills the water it takes from the loop and delivers the heat to the space. When the control calls for cooling, the unit operates as a water cooled air conditioner. By installing multiple units on a single loop, there is a transfer of energy or heat recovery between zones. Data are presented showing the difference between an old steam radiation system and the new heat recovery system operation.

16980 **(DOE/SF/01910—T2) Water conservation in the home. Final report.** Koga, N.N. (Hawaii Community Design Center, Honolulu (USA)). [nd]. Contract FG03-78SF01910. 24p. NTIS, PC A02/MF A01.

Ways of conserving water in the home are detailed for: the toilet; showers and baths; laundry; dishwasher vs handwashing; garbage disposal; drinking and cooking; lavatory uses; and outside uses. Conservation of water by recycling wastewater, utilizing a composting toilet and a trickle filter, is discussed.

3202 Transportation

REFER ALSO TO CITATION(S) 17058, 17059, 17060, 17064

16981 **(DOE/IR/10999—1) Bicycle Promotion Plan.** Simone, G.A. (Uniworld Group, Inc., Bethesda, MD (USA)). 9 Mar 1981. Contract AC01-80IR10999. 65p. NTIS, PC A04/MF A01.

The objective of this Bicycle Promotion Plan is to outline a set of recommendations and supporting strategies for implementa-

tion by the US DOE toward increased use of the bicycle for energy conservation. The recommendations are designed in such a way as to function in concert with: (1) bicycle programs administered by other Federal government agencies; and (2) related programs and activities already sponsored by DOE. The approach to preparation of the Plan involved a review of all current and planned bicycle promotion programs at the Federal level as well as a review of the array of literature on the subject. The UniWorld project staff also interacted with several DOE program offices, in order to determine the extent to which they might appropriately contribute to the implementation of bicycle promotional efforts. A synthesis of all the information gathered was published in January of 1981 as a part of the project (The Bicycle Program Review). Based upon this information and an examination of the barriers to bicycle use identified by bicycle transportation specialists in the field, UniWorld developed a series of the most potentially effective recommendations and program strategies for implementation by DOE. The recommendations address activities that could be undertaken in conjunction with existing DOE programs, new developments that might be considered to fulfill critical needs in the field, and interagency efforts that DOE could play a role in.

16982 **(PB—80-208218) Proposed rear view mirror characteristics and costs. Final report, January-April 1980.** Mattson, S.; Cross, A.; Wakeley, H.; Viergutz, O.J. (IIT Research Inst., Chicago, IL (USA)). Apr 1980. Contract DOT-HS-9-02112. 49p. NTIS, PC A03/MF A01.

A manufacturing/consumer cost analysis was performed comparing four families of mirror configuration (minimal required for regulation compliance, manufacturer's standard equipment, optional or upmarket, and aftermarket equipment) under present and proposed mirror regulations. Fleet composition (vehicles and mix of mirror configurations) was considered. Representative designs for each family were described with provision for breakaway or foldaway impact protection shown. Effects on fuel economy/consumption, capital equipment and tooling requirements, and maintenance impact were discussed. Significant differences in fuel economy were related to the addition of aftermarket mirror configurations to the model. These designs provide coverage exceeding requirements with accompanying increased weight and frontal surface area.

16983 **(PB—80-219728) Cost analysis for upgraded passenger car rear signal lighting requirements. Final report, December 1979-June 1980.** McLean, R.F.; Wakeley, H.; Viergutz, O.J. (IIT Research Inst., Chicago, IL (USA)). Mar 1980. Contract DOT-HS-9-02112. 98p. NTIS, PC A05/MF A01.

A production cost analysis was performed on four candidate vehicle rear signal lighting system upgrades. The systems studied were: (1) a high-mounted brake (stop) lamp only; (2) a deceleration signal only; (3) combination of high-mounted brake lamp and the deceleration signal; and a (4) mandatory yellow (amber) rear turn signal lamp. The specific performance levels for the systems were established and the necessary changes in vehicle hardware were determined. Two of each market size class of vehicles were selected for design studies and quarter-scale design layouts of the vehicle modifications were made. Using standard production cost estimating techniques, the consumer costs of each of the four upgraded systems were estimated. Assuming any upgraded rear lighting requirements to become effective on 1983 models, the effects of leadtime on the manufacturers is discussed. The effects on fuel operating and maintenance costs are considered.

16984 **Energy and transportation: issues for California.** Sacramento, CA; California Energy Commission (1980). 74p. (NP—25376).

Policies and programs which could satisfy both energy and mobility goals in California are discussed. An historical perspective, sector characteristics, accomplishments, and emerging trends are noted. Opportunities and constraints for conserving transportation fuel for the 1980s by: vehicle fuel efficiency, driving habits, optimized fleet scheduling/routing, improved traffic flow, increased load factors/shifts to efficient modes and for the next 20 years and beyond by: advanced vehicle technologies, alternative fuels/engines, mass transportation, and improved land use planning/communications are covered. Recommended initiatives involving legislative and administrative actions are discussed. (MCW)

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 16402, 16720, 16802, 16893, 16897, 16958, 16970, 17043, 17055

16985 **(ANL/CNSV—11) Energy and materials flows in the copper industry.** Gaines, L.L. (Argonne National Lab., IL (USA)). Dec 1980. Contract W-31-109-ENG-38. 104p. NTIS, PC A06/MF A01.

The copper industry comprises both the primary copper industry, which produces 99.9%-pure copper from copper ore, and the secondary copper industry, which salvages and recycles copper-containing scrap metal to extract pure copper or copper alloys. The United States uses about 2 million tons of copper annually, 60% of it for electrical applications. Demand is expected to increase less than 4% annually for the next 20 years. The primary copper industry is concentrated in the Southwest; Arizona produced 66% of the 1979 total ore output. Primary production uses about 170 x 10^{12} Btu total energy annually (about 100 x 10^{6} Btu/ton pure copper produced from ore). Mining and milling use about 60% of the total consumption, because low-grade ore (0.6% copper) is now being mined. Most copper is extracted by smelting sulfide ores, with concomitant production of sulfur dioxide. Clean air regulations will require smelters to reduce sulfur emissions, necessitating smelting process modifications that could also save 20 x 10^{12} Btu (10 x 10^{6} Btu/ton of copper) in smelting energy. Energy use in secondary copper production averages 20 x 10^{6} Btu/ton of copper. If all copper products were recycled, instead of the 30% now salvaged, the energy conservation potential would be about one-half the total energy consumption of the primary copper industry.

16986 **(ANL/CNSV—15) Energy and materials flows in the production of liquid and gaseous oxygen.** Shen, S.; Wolsky, A.M. (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 37p. NTIS, PC A03/MF A01.

Liquid and gaseous oxygen is produced in an energy-intensive air separation processo that also generates nitrogen. More than 65% of the cost of oxygen is attributable to energy costs. Energy use and materials flows are analyzed for various air separation methods. Effective approaches to energy and material conservation in air separation plants include efficient removal of contaminants (carbon dioxide and water), centralization of air products user-industries so that large air separation plants are cost-effective and the energy use in transportation is minimized, and increased production of nitrogen. Air separation plants can produce more than three times more nitrogen than oxygen, but present markets demand, at most, only 1.5 times more. Full utlization of liquid and gaseous nitrogen should be encouraged, so that the wasted separation energy is minimized. There are potential markets for nitrogen in, for example, cryogenic separation of metallic and plastic wastes, cryogenic particle size reduction, and production of ammonia for fertilizer.

16987 **(ANL/CNSV-TM—55) Implementation planning for industrial energy conservation: approach and methodology.** Alston, T.G.; Falk, G.; Grogan, P.J.; Katz, D.; Tatar, J. (Argonne National Lab., IL (USA)). Jan 1981. Contract W-31-109-ENG-38. 46p. NTIS, PC A03/MF A01.

Details of an industry-specific Conservation Technology Implementation Branch implementation plan is described in detail. CTIB has conducted implementation planning in the steel, pulp/paper, and agriculture/food processing industries, but in FY 1981, CTIB plans to conduct planning for the chemicals, petroleum refining, aluminum, glass, cement, and textile industries. Guidelines are presented for each contractor for each industry toward a common methodology in terms of approach, areas of analysis, assumptions, and reporting. The major parts of the CTIB plan are: an implementation study consisting of technology selection, market demand analysis, and policy analysis, and a plan consisting of a detailed description and schedule of future CTIB actions, followed by a recommended system for monitoring market results when the plan is implemented. (MCW)

16988 (CONF-800483—(Vol.2)) **Industrial Energy Conservation Technology.** (Texas Industrial Commission, Austin (USA)). 1980. Contract FC01-75IR08141. 427p. NTIS, PC A19/MF A01.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

A separate abstract was prepared for each of the 55 papers presented in this volume, all of which will appear in Energy Research Abstracts (ERA); 18 were selected for Energy Abstracts for Policy Analysis (EAPA). (MCW)

16989 (CONF-800483—(Vol.2), pp 436-440) **Thermal energy storage/heat recovery and energy conservation in food processing.** Combes, R.S.; Boykin, W.B. (Georgia Inst. of Tech., Atlanta). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Modern food-processing operations often require that the temperature of the processed foodstuff be raised or lowered. These operations result in energy consumption by refrigeration or heating systems, and a portion of this energy can be recovered from waste heat streams for reuse in the processing operations. This paper addresses the recovery of waste heat and the storage of thermal energy as a means of energy conservation in food processing. An energy conservation project in a poultry processing plant is used as an illustrative example of potential applications of heat recovery and thermal energy storage.

16990 (CONF-800483—(Vol.2), pp 441-447) **Production of biogas from waste waters of food-processing indusries.** Sax, R.I. (Joseph Oat Corp., Camden, NJ); Holtz, M.; Pette, K.C. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

An Upflow Anaerobic Sludge Blanket Process used in converting biodegradable, soluble, organic pollutants in industrial waste waters to a directly-burnable biogas composed mainly of methane was developed, tested, and commercially applied in Holland. Operations on waste water from the processing of sugar beets have shown hydraulic retention times of less than 10 hours with reactor loadings of at least 10 kg COD per m^3 digester volume per day and purification efficiencies exceeding 90%. Biogas production is at a rate of about 1 therm (100,000 Btu) per 10 kg COD treated. A moderately sized (1000 m^3) waste water treatment plant processing the order of 10,000 per day will, therefore, produce the order of 1000 therms of energy per day while, at the same time, reducing the COD level in the effluent by an order of magnitude.l The set of conditions required for efficient operation of this anaerobic process is discussed. The process is unique in its mixed-sludge-bed approach allowing for tolerance of swings in Ph (6 to 8) at relatively low temperatures (32 to 38°C) which can be readily achieved from most waste water streams with little expenditure of additional energy. Sludge production is remarkably low, only about 5% of the COD loading, greatly alleviating disposal problems. These characteristics are conducive for the use of the anaerobic process to recover energy from a variety of waste waters rich in carbohydrate-type substances as produced routinely as a by product of many types of food processing activities.

16991 (CONF-800483—(Vol.2), pp 459-465) **Plant energy-cost-optimization program (PECOP).** Robinson, A.M. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The Plant Energy Cost Optimization Program (PECOP) is a management system designed to reduce operating cost in a continuous operating multi product plant by reviewing all cost factors and selecting plantwide production schedules which are most economical and efficient. Key requirements include production units and energy systems that are operating below full capacity, storage for production inventory, economic data on fuel and electrical costs, production plans, and energy efficiency ratings of various components. The requirements are integrated via alternative operating techniques such as block operating, adjusting maintenance schedules, and coordinating startup and shutdown schedules to optimize operating costs.

16992 (CONF-800483—(Vol.2), pp 466-473) **Why energy audits aren't enough: an energy management system is required.** Haft, A.J. (Gilbert/Commonwealth, Jackson, MI). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

An evaluation of the energy systems in a plant can be accomplished by different techniques which require different levels of effort. Three alternatives are described: rational analysis, energy audits, and energy management by utility-systems metering. A progressively greater investment in time and funding is required; however, the results yield more information and greater accuracy about energy usage. It is recommended that the step beyond energy audits, an energy management system, be taken. The energy management system approach is worthwhile, and the additional time and funding will be returned in energy cost reductions.

16993 (CONF-800483—(Vol.2), pp 474-481) **Comprehensive energy audit of a large production unit in six weeks.** Korich, R.D. (Union Carbide Corp., Seadrift, TX). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Past energy audits of petrochemical-plant production units at Union Carbide have demonstrated that the key to an effective, comprehensive audit of a large production unit is to minimize the time period requirement for the team activity. This paper describes a comprehensive energy audit performed in six weeks on a large and relatively new production unit. This audit resulted in identifying and evaluating 62 opportunities reducing annual energy usage by $2,000,000.

16994 (CONF-800483—(Vol.2), pp 482-487) **Energy audits on Prince Edward Island.** Hall, N.G.; Gillis, D. (Univ. of Prince Edward Island, Charlottetown). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

High energy costs and uncertain supplies force industrial operators to seek out energy waste to keep costs down. The Enersave for Industry and Commerce program assists Prince Edward Island industries through an energy-audit and grant program. A typical audit shows how one processor doubled his output with no increase in energy use.

16995 (CONF-800483—(Vol.2), pp 488-493) **High-efficiency burners by retrofit: a simple inexpensive way to improve combustion efficiency.** Rogers, W.T. (Coppus Engineering Corp., Worcester, MA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Existing direct-fired process heaters and steam boilers can have their efficiencies remarkably improved by conversion from conventional-type natural-draft burners to high-intensity, forced-draft type burners. An available type that is forced draft, but which does not require expenditure of energy for forced draft, is discussed. Combustion air is automatically controlled by the fuel flow - which fuel drives the forced draft fan to control airflow. Use of such burners can, in many instances, increase efficiency to a point close enough to that obtainable by addition of air preheat until the difference in efficiency with air preheaters will not justify the high cost of air-preheat systems. Low-excess air and short, high-intensity flame patterns assure reduction of stack temperature, thus increased efficiency. Conversion can be made on-the-fly without shutting down the fired heaters or boilers by insertion of an installation package of the burners into openings left after removal of conventional burners.

16996 (CONF-800483—(Vol.2), pp 503-506) **Wood-coal fired small boiler case study.** Pincelli, R.D. (Energy Systems, Inc., Chattanooga, TN). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Galaxy Carpet Corporation installed a coal and wood waste-fired boiler at its mills. A summary of operational experiences is given. Efficiencies and payback periods are indicated.

16997 (CONF-800483—(Vol.2), pp 507-516) **Analysis and development of large industrial steam systems.** Waterland, A.F. (Waterland, Viar & Associates, Inc., Wilmington, DE). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Chemicals, petroleum, pulp and paper, and many other industries depend heavily on extensive complex steam systems for thermal and mechanical energy delivery. Steam's versatility and desirable characteristics as both a heat-transfer medium and a working fluid has fostered and perpetuated this dependency throughout industrial history. Many large-process operations, however, have not developed their steam systems to keep pace with rapidly changing energy economics. As a result, the use of steam in industrial plants seldom approaches the optimum levels of first- or second-law efficiency. At each of many industrial complexes today, tens of millions of energy dollars per year are literally wasted. A description of some case histories comparing actual and optimum steam-system configurations and operational concepts is given. Highly effective steam-system analytical techniques developed and used by the author are discussed. These include energy-level mass balancing; the three-branch thermodynamic system; and power sophisticated digital computer steam-system models. These latter are really working models on which development options can be tried and actively evaluated for economic and technical feasibility. The principal of steam as a plant-wide integrating energy system is explained and demonstrated with examples. These show how a properly structured and effectively operated steam system can increase operational flexibility and facilitate the practical implementation of many energy-conservation opportunities in process and plant-service areas.

16998 (CONF-800483—(Vol.2), pp 517-527) **Cogeneration at a practical plant level.** Feuell, J. (Coppus Engineering Corp., Worcester, MA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

A basic description is presented of how a steam turbine converts available heat into mechanical energy to define the formula used for the cost comparisons in examples discussed in the paper. Examples discussed are cogeneration, process power recovery, steam vs electric motor, and waste heat recovery.

16999 (CONF-800483—(Vol.2), pp 528-534) **Large field-erected and packaged high-temperature-water (HTW) generators for coal firing.** Boushell, C.C. (International Boiler Works Co., East Stroudsburg, PA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Information is presented on the energy savings possible with high-temperature water (HTW) for heating and industrial process application and informtion on coal-fired HTW generator design and availability is provided.

17000 (CONF-800483—(Vol.2), pp 535-542) **Choosing power cables on the basis of energy economics.** Dimachkieh, S.; Brown, D.R. (Univ. of Texas, Austin). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Feeder-circuit and branch-circuit cable sizes are determined primarily on the basis of ampacity and voltage-drop considerations. Rising costs of energy suggest a reassessment of currently used voltage-drop criteria. Some degree of cable oversizing reduces cable resistance and cable operating temperature resulting in lower cable losses. A simplified method of analysis is presented which incorporates the effects of cable operating temperature. The analysis permits determination of cable-loss savings for various choices of cable sizes. The method is extended to include cost of cable and expected future costs of energy so that an economical choice of cable size may be determined. An example is presented to illustrate the method. It is shown that a relatively simple modification of currently used ampacity tables permits determination of cable sizes taking into account today's energy economics.

17001 (CONF-800483—(Vol.2), pp 543-545) **Conservation theory process control using variable frequency drives.** Myers, N.S. (Industrial Drive Maintenance, Inc., Houston, TX). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Some of the economic considerations of variable frequency control are outlined in order to create greater awareness of the options available to the engineer as he develops new facilities and improves old ones. The Variable Frequency Controller or Inverter, which has the capability of controlling the speed of a standard induction motor, was considered too costly or too complex for many process control applications where more common methods such as eddy current drives, wound rotor motors, hydraulic couplings, throttle valves, etc., could be utilized. Improved technology and cost reduction of the inverter coupled with the increased cost of energy have dramatically altered the value of the inverter drive as a tool to save energy dollars.

17002 (CONF-800483—(Vol.2), pp 546-558) **Practical procedures for auditing industrial boiler plants.** O'Neil, J.P. (Nabisco, Inc., East Hanover, NJ). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Industrial boiler plants are an area of opportunity in virtually every industry to save energy and reduce costs by using relatively simple, inexpensive auditing procedures. An energy audit consists of inspection, measurement, analysis, and the preparation of recommendations. A complete boiler-plant program will consider each individual boiler, boiler-room auxiliary equipment, steam distribution and return systems, and steam end-use equipment. This paper summarizes the practical procedures, techniques, and instrumentation which Nabisco uses in its boiler-plant energy-conservation program.

17003 (CONF-800483—(Vol.2), pp 559-564) **Combustion air preheat should be more than supply recycling energy.** Grantom, R.L. (Monsanto Co., Alvin, TX). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Combustion air preheat can and should result in fuel savings far in excess of the energy added to the combustion air. In a typical installation of air preheat on a fired tubular reactor, the addition of 2.5 million Btu/h to the combustion air results in a fuel savings of 6.8 million Btu/h. Control of excess effects of excess combustion air on radiant heat transfer in a fired tubular reactor, the point at which air preheat does become simply recycling energy, and the point at which any advantage of air preheat is lost entirely are discussed. How air preheat and excess air influence radiant heat transfer is discussed, and a calculation method can be used to develop justification for improved excess air control is presented.

17004 (CONF-800483—(Vol.2), pp 565-576) **Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers.** Miller, B.; Keon, E. (Apollo Technologies, Inc., Whippany, NJ). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Chemical technology has been used successfully to solve many of the operational and emissions problems that result from burning coal. This paper describes the use of blended chemical flue-gas conditioners to significantly reduce particulate emissions in coal-fired industrial boilers. In many cases, these chemical conditioning agents have increased the efficiency of electrostatic precipitators and mechanical collectors by more than 50%. The effectiveness of this technology has been demonstrated on units generating 50,000 to 200,000 lbs/h steam. Results achieved at various industrial plants under actual operating conditions are presented.

17005 (CONF-800483—(Vol.2), pp 577-581) **Oxygen and opacity stack-emission monitoring systems to optimize combustion efficiency and meet EPA requirements.** Molloy, R.C. (Dynatron Inc., Wallingford, CT). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The combustion efficiency of industrial fuel-burning equipment can be optimized through the use of oxygen and opacity

stack-emission-monitoring systems. By providing the operator with the means to obtain accurate, continuous, dynamic feedback of the status of the products of combustion fuel-air-mixture, ratios can be maintained at optimum levels - resulting in improved combustion efficiency and reduced air pollution in compliance with EPA guidelines. The smoke going up the stack is to a large part unburned fuel. The ever-spiraling cost of fuel over the past few years coupled with the world-wide energy shortage has made it imperative to operate industrial fuel-burning equipment at the highest level of operating efficiency possible. A wide variety of fuel-burning emission sources can now economically use oxygen and opacity-monitoring systems to optimize combustion efficiency and meet EPA requirements. These are briefly discussed.

17006 (CONF-800483—(Vol.2), pp 582-592) **Cogeneration considerations in the 1980's.** Kovacik, J.M. (General Electric Co., Schenectady, NY). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The increasing cost of both purchased fuel and power will be the incentive to maximize the output available from cogeneration energy-supply systems. This paper reviews steam and combined-cycle cogeneration systems available to industrials requiring large quantities of process heat and power. Examples are developed to illustrate the economic benefit of improved systems as energy costs increase.

17007 (CONF-800483—(Vol.2), pp 593-600) **Case studies of industrial cogeneration in the US.** Limaye, D.R.; Isser, S.; Hinkle, B.; Hough, T. (Synergic Resources Corp., Bala-Cynwyd, PA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Results of a survey and evaluation of plant-specific information on 17 industrial cogeneration facilities are presented. The study was performed as part of a project sponsored by the Electric Power Research Institute to evaluate Dual Energy Use Systems (DEUS). The purpose of this project was to evaluate site-specific data on DEUS from the utility perspective, identify promising candidates, and define R & D opportunities. The first major task in this DEUS project was a survey of industrial-cogeneration sites to identify the techno-economic and institutional factors affecting the success of cogeneration systems in industry. Sites were selected based on a mix of industry types, geographic location, type of cogeneration system, generating capacity, age of plant, and other characteristics. Site-specific surveys were conducted and supplemented by information from secondary sources such as FERC and DOE statistical-data systems. Eleven utilities were surveyed about involvement with DEUS operations, and their attitudes (or concerns) are enumerated.

17008 (CONF-800483—(Vol.2), pp 601-611) **Economics of steam/electric generation.** Ophaug, R.A. (Board of Water & Light); Birget, C.D. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The economics of combining steam and electric generation for companies requiring both steam and electric services develop a challenge which few engineers and economists can realize. This paper outlines the general approach to this challenge and the procedure for reaching an equitable solution. The approach uses a system of programs that meet both present and future requirements. Each program has different operating costs and capital investments spread over an extended period of time. Simple load-growth procedures establish the future requirements, and noncomputerized construction schedules guide the procedure to completion. Capital expenditures, by this approach, are established and are then combined with operating costs. The present-worth system is then used to evaluate each program. This system is also adjusted to show the effect of inflation and other variables affecting the evaluation. This procedure allows each system to be summarized, with or without inflation, to assist management in reaching an equitable solution to the problem.

17009 (CONF-800483—(Vol.2), pp 612-621) **Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities.** Mesko, J.E. (Pope, Evans and Robbins Inc., New York, NY). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Economic analysis of the construction and operation of by-product electric power and steam/power cogeneration systems in coal-fired fluidized-bed steam cycles, located at individual industrial sites is presented. The plants analyzed employ fluidized-bed boilers for generation of steam for process and building/heating/cooling demands, in conjunction with electric power cogeneration. Results of the analysis are presented, using life-cycle costs and investment-payback periods, pin-pointing the areas, type, and magnitude of costs that should be considered in the selection of combustors or systems. Capital and operating costs and regognized technical and economic barriers are also presented and their effects indicated. Life-cycle costs of the alternatives analyzed are compared, and the expected payback periods for the different-size FBC plants and for different annual average production levels are discussed.

17010 (CONF-800483—(Vol.2), pp 622-629) **Fluid catalytic-cracking power-recovery dynamic computer simulation.** Samurin, N.A. (Elliott Co., Jeannette, PA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Fluidic Cat Crackers (FCC) using the catalyst regeneration cycle are candidates for more-power-efficient operation by the use of high-temperature dirty-gas expanders. Earlier, a computer simulation was developed for the steady-state operation of the primary mechanical components, specifically the axial compressor and hot-gas expander; this paper expands the steady-state model to add the dynamic characteristics of these elements as well as the effects of the controlling process valves. In many applications the expander will develop more power than the axial compressor can absorb. A power-absorbing source, specifically an electrical generator, converts the mechanical excess power into electrical energy. A review of the mechanical equipment and the electrical generator operating modes and controls is needed so that the process designer and operator will know how the system will respond if process upsets were to occur. The program code developed can simulate these elements for specific processes and demonstrate the logic control scheme proposed by the process designer. This information will therefore allow the process operator, process designer, and mechanical-equipment supplier and understanding of the interplay of the system control elements and define specific operating limits.

17011 (CONF-800483—(Vol.2), pp 630-636) **Organic Rankine Cycle System: its application to extract energy from low-temperature waste heat.** Sawyer, R.H.; Ichikawa, S. (AFI Energy Systems, Livingston, NJ). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Conservation of energy by its recovery from low-temperature waste heat is of increasing importance in today's world energy crisis. The Organic Rankine Cycle is a cost-efficient and proven method of converting low-temperature (200 to 400°F) waste heat to mechanical and/or electrical energy. Applying the Organic Rankine Cycle technology to typical liquid and mixed-component condensing streams is described using actual examples. Selection of the organic working fluid is explored. The Rankine Cycle efficiency is directly dependent upon the temperature difference between its evaporating and condensing phases. The evaporating level is set by the heat source; therefore, to maximize efficiency, it is essential to obtain the lowest condensing temperature practical. Various condensing schemes are discussed emphasizing methods of optimizing the net output of the total system. Several Organic Rankine Cycle commercial applications are summarized with experience and general performance given. The economics and optimization techniques in typical applications including multiple heat sources are discussed.

17012 (CONF-800483—(Vol.2), pp 637-642) **Power generation from waste heat using organic Rankine cycle systems.** Prasad, A. (Sundstrand Energy Systems, Rockford, IL). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The use of organic Rankine-cycle engines to generate power from waste heat provides a near-term means to greatly increase the fuel utilization efficiency of many processes. Sundstrand has developed a 600-kW ORC unit to recover energy from various waste heat sources. A field-test program (5 units) is demonstrating the economic viability and the reliability of the equipment in commercial and industrial applications. This paper describes the system and the field-test program.

17013 (CONF-800483—(Vol.2), pp 643-649) **Cost-effective waste-heat Organic Rankine Cycle application and systems designs.** Rohrer, J.W. (Wheelabrator-Frye, Inc., Hampton, NH); Bronicki, L.Y. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Conceptually, the Organic Rankine Cycle (ORC) power cycle has been well known to the engineering community for many years. Despite the rapid escalation of energy costs during the past decade, and a concerted, though somewhat belated, effort towards industrial energy conservation, very few industrial ORC systems have been installed. The level of technical interest on the part of potential users is high and cannot be blamed for the lack of installations to date. Technical risks are low with systems becoming commercially available. The authors feel the key to increased usage of ORC systems for inustrial energy conservation lies in combining cost-effective ORC system designs with well-selected applications. An appreciation of the factors considered by ORC systems designers is provided. A simple framework, admittedly crude, is provided to assist those attempting to identify and rank order potential ORC applications within their process plant or company.

17014 (CONF-800483—(Vol.2), pp 650-656) **Low level heat recovery through heat pumps and vapor recompression.** Gilbert, J. (Mechanical Tech. Inc., Latham, NY). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Methods and economics of recovering low-level heat through heat pumps and vapor recompression are examined. Actual commercially available equipment is considered to determine the near-term and future economic viability of each approach as a function of the source and sink temperatures and magnitude of heat flow. Generic heat pumps and vapor-recompression designs are explained, costed, estimated in performance, and evaluated as a function of the economic parameters such as local utility and fuel rates, hours of operation, investment tax credits, and other standard investment variables. The results are presented in a manner that permits simple economic evaluation of these technologies.

17015 (CONF-800483—(Vol.2), pp 657-669) **Evaluation of industrial heat pumps for effective low-temperature heat utilization.** Leibowitz, H.M.; Colosimo, D.D. (Mechanical Tech. Inc., Latham, NY). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The implementation of industrial heat pumps utilizing waste water from various industrial processes for the production of process steam is presented as a viable economic alternative to a conventional fossil-fired boiler and as an effective fuel-conservation measure. With advanced, high-performance industrial turbocompressors capable of delivering 45,000 feet of head at 60,000 acfm, waste-stream temperatures as low as 140°F can be used economically. Three heat-pump systems are described and presented schematically, different primarily in the heat-exchange strategy from the effluent to the heat pump power fluid. Detailed studies were made of two open-type Rankine-cycle systems using water vapor as both the heat pump and process fluid. The heat pump capital cost, maintenance, and electric-power costs are calculated through the year 2000 to determine the amortized cost of the process steam and are compared with conventional fossil-fuel-generated steam costs. Heat-pump capacities range from 10,000 lb/h to 250,000 lb/h of process steam. System variables such as the waste-stream temperature, process temperature, heat exchanger, and approach ΔT are evaluated parametrically. The salient features of the vapor turbocompressor, the heat pump's major component, are described. The high-performance turbocompressor is capable of head capacities of 45,000 feet at 80% isentropic efficiency, using a centrifugal impeller driven through a geared speed increaser. Tip speeds and rotational speeds up to 1500 ft/sec and 52,000 rpm, respectively, are characteristic of present-day, high-performance compressors for industrial process applications.

17016 (CONF-800483—(Vol.2), pp 670-673) **Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide.** DeVivo, D.G. (Econics Corp., Sunnyvale, CA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

A microcomputer-based control system utilizing a distributed-intelligence architecture was developed to control combustion in hydrocarbon fuel-fired boilers and heaters to significantly reduce fuel usage. The system incorporates a unique flue-gas analyzer that mounts directly in the flue or stack to continuously measure carbon monoxide, unburned hydrocarbons, opacity, and temperature. The control console interfaces directly with the boiler's existing analog control system to provide precise air:fuel ratio control based on carbon monoxide measurements. Significant decreases in excess air result in reduced fuel usage while meeting steam demand. Actual performance on industrial boilers shows increases in efficiency of from 1 to 3% with substantial fuel savings. The Econics 700 Fuel Optimization System is described.

17017 (CONF-800483—(Vol.2), pp 674-687) **Control-system design for effective energy utilization: a case study.** Dziubakowski, D.J.; Keys, M.A. IV. (Bailey Controls Co., Wickliffe, OH). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The activities and results of a typical plant powerhouse energy-management survey are described. The powerhouse provides electrical energy, steam supply at two different pressure levels, and compressed air for the process plant. The owners had already performed energy-loss surveys and implemented maintenance and energy-management programs. The actvities described include a follow-up survey and a concentration on the improvement of the boiler operations and efficiencies. The input-output and heat-loss methods of determining boiler efficiency, in accordance with ANSI & ASME PTC4.1, are explained. A comparison of the methods, including a sensitivity analysis, shows the effects of measurement inaccuracies on each. Each boiler is studied and the required measurements identified and described. The importance of flue-gas oxygen measurements is described along with the variations in readings obtained using dry-or wet-basis measurements. The existing operating efficiency of each boiler is determined and the effects of improved controls identified. The considerations for security, reliability, maintainability, and efficiency improvement required by any control system are described. A control strategy is selected and hardware chosen to implement the improved boiler and overall steam generation performance. Focus is shifted from the single-boiler problem to the requirements for optimal loading of each boiler to meet total-system-load requirements; the economics of multiple boiler loading is discussed.

17018 (CONF-800483—(Vol.2), pp 688-694) **Industrial-boiler optimization utilizing CO control.** Ruoff, C.W.; Reiter, R.E. (Hercules Inc., Hopewell, VA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

This paper discusses the approach of a large chemical company that is effectively utilizing a direct digital control (DDC) system coupled with the measurement of carbon monoxide to optimize boiler combustion and generate steam in the most cost-effective manner. Significant reductions in the amount of excess air resulted from the use of CO as a control parameter. Previously, combustion effectiveness was determined by the more-typical O_2 measurement. For reasons of boiler leakage and gas stratification, this control technique was not suitable when operating close to stoichiometry. The use of DDC-tupe control in the multiple-boiler installation also enabled the intelligent allocation of boiler capacity by evaluating steam demand versus incremental-boiler-steam cost. The system selectively increases or decreases boiler loads within specified constraints to provide the lowest overall steam production cost while continuing to meet the steam demand.

17019 (CONF-800483—(Vol.2), pp 700-711) **Energy conservation in French industry and at Rhone-Poulenc.** Mongon, A. (Rhone-Poulenc, Paris, France). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

France imports 75% of its primary energy. In 1985 this dependence on imported energy will decrease, but remain at 60%. Energy conservation and energy recovery are therefore of dramatic importance. Industry has always taken care of energy management in order to get the best production prices. But since 1973, with the help of various governmental procedures, great efforts have been made to use energy in the most-efficient way. Examples are given to show: the most efficient way of energy-sources management, the application of the process optimization method, and the use of control equipment for process and heating. Rhone-Poulenc, the world's ninth-ranked chemical group and second largest industrial energy consumer in France, has worked for energy conservation in three directions: management, education, and investment. The primary energies are transformed for thermal or mechanical purposes. This transformation has to be the most efficient: combined production of heat and electricity by means of steam or gas turbines is highly developed at Rhone-Poulenc. The experience of a ten-gas-turbine plant with heat-recovery boilers is described. But the coming of nuclear energy and the scarcity and rise of prices of fossil fuels reduce the interest in combined production. The optimum use of energy in the various production processes needs investments to improve the existing plants or to build new plants designed on an entirely new process. Various examples are given.

17020 (CONF-800483—(Vol.2), pp 712-717) **Energy use management: one company's story.** Burns, A.B. (Union Carbide Corp., New York, NY). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Rapidly increasing energy prices, as well as increasingly uncertain supplies, have caused some fundamental readjustments in the ways industrial corporations manage their energy use. At Union Carbide, the initial response was to establish energy-use and planning programs, centralize energy planning, and implement energy-conservation programs. Second, the company has had a period of reexamining and revising those mechanisms and fully integrating energy-use management into basic operations and business planning. Finally, the company feels that as energy takes a firm position as a prominent operating factor, less reliance on formal structures and programs to manage it will be needed; it will become another significant responsibility of all line management.

17021 (CONF-800483—(Vol.2), pp 718-724) **Energy Responsibility Accounting: an energy-conservation tool for industrial facilities.** Kelly, R.L. (General Motors Corp., Detroit, MI). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Energy Responsibility Accounting (ERA) is a tool that improves management's control of energy through accurate measurement of energy usage and costs by plant burden centers. The concept of responsibility accounting involves the continuous flow of information throughout an organization for the purposes of planning and cost control. ERA extends factory responsibility accounting systems to include energy. A summary of GM's conservation performance, ERA philosopy, ERA implementation and concepts for performance reporting, and the benefits of Energy Responsibility Accounting is presented.

17022 (CONF-800483—(Vol.2), pp 725-730) **Saving money through employee motivation and participation in energy conservation.** Tomlin, W. (Garrett Manufacturing Ltd., Rexdale, Ontario). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Actions taken since 1975 at Garrett Manufacturing Ltd. (GML) to conserve energy in the operational activities are described. GML is an aircraft electronic/electro-mechanical manufacturer and, compared to many companies, energy costs are only a small proportion of total cost of operating. Organizing a program is described, and recommendations are summarized.

17023 (CONF-800483—(Vol.2), pp 731-733) **Commercial and industrial energy conservation programs in Illinois.** Thomas, S.K. (Illinois Inst. of Natural Resources, Springfield). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The State of Illinois' evolving role in assisting commercial and industrial firms in identifying and improving inefficiencies in the use of energy is presented. Assistance is provided through the dissemination of conservation practices, fuel switching opportunities, and renewable energy sources. Primary attention is given to citizens, businesses, and institutions most severely affected by higher energy costs; and to the builders and suppliers of new buildings and equipment.

17024 (CONF-800483—(Vol.2), pp 734-738) **Field-tested model of industrial energy-conservation assistance to small industries.** Jendrucko, R.J.; Mitchell, D.S.; Snyder, W.T.; Symonds, F.W. (Univ. of Tennessee, Knoxville). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The University of Tennessee Energy Analysis and Diagnostics Center (EADC) has completed 52 industrial energy audits of Tennessee manufacturing firms from which over 150 feasible energy-conservation opportunities (ECO's) have been identified and analyzed. The process consists of: (1) analyzing energy consumption and costs for a two-year period; (2) conducting a one-day on-site energy audit; (3) analyzing each ECO for potential energy-consumption and cost savings; (4) preparing a technical report to the firm which contains specific recommendations of economically feasible ECO's; and (5) providing the firm with the appropriate financial analysis. The main emphasis of the process is on quantification of potential energy savings so that the firm has the necessary quantitative data for making a capital-investment decision. The average benefit/cost ratio of the EADC program has been calculated to be approximately 8. Reduction in annual energy consumption identified from the ECO's was approximately 13% and reduction in annual energy costs was approximately 10%. The entire process is described in sufficient detail to permit other universities to follow the field-tested methodology and develop their own programs.

17025 (CONF-800483—(Vol.2), pp 766-776) **Use of a conversational computer program in operator training for improved energy efficiency.** Brickman, S.W. (Shell Canada, Ltd., Toronto, Ontario); Mergens, E.H. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Energy-efficient operation of process equipment requires attentive operation by well-trained personnel. Use of a computer-simulation model together with a conversational computer program, which provides dynamic game-playing opportunities for the trainee, has proven a very effective training tool. The programs have been used in plants and refineries, and they demonstrate the ability to develop rapidly within the Operator Trainee a real understanding of the variables affecting process performance. Experience with a furnace-firing computer training program is described. Using a time-share computer terminal, the operator participates in a conversational training experience in which he is taught startup, routine operation, and to cope with operating problems on a gas- and/or oil-fired process furnace. Specific operator-oriented problems are encountered and solved by making control adjustments in the Simulator program. In using the program, the trainee is challenged to achieve or exceed firing-efficiency goals set for the furnace. A variety of operating conditions are presented. As an extension of the success experienced with the furnace program, a new program has been developed simulating a crude oil distillation unit. The Distillation Column Operator training program is designed to facilitate an understanding of distillation principles and the effect on energy efficiency for the various product quality and yields achieved. The results of operator acceptance of these programs is that a wider application of the principle's computer simulator training to other industry processes is warranted.

17026 (CONF-800483—(Vol.2), pp 782-790) **Practical approach to process analysis and improvement for energy conservation.** Shiroko, K.; Umeda, T. (Chiyoda Chemical Engineering & Construction Co., Ltd., Yokohama, Japan). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

A practical approach to process analysis and improvement for energy conservation was developed by establishing the required technical basis, which arises from the first and the second laws of thermodynamics. As the tool for process analysis for the present purpose, the so-called heat-availability diagram was used. The status of energy utilization, the loss of available energy due to process irreversibility, and the bottleneck on improving energy utilization are described. Several practical examples are taken up for illustrative purposes.

17027 (CONF-800483—(Vol.2), pp 791-795) **Approach to evaluating equipment-efficiency policies.** Newsom, D.E.; Evans, A.R. (Argonne National Lab., IL). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The National Energy Conservation Policy Act of 1978 authorized studies of several types of industrial equipment to evaluate the technical and economic feasibility of labeling rules and minimum energy-efficiency standards. An approach to the evaluation of these and related policy options is under development. The approach includes equipment classification and characterization, market characterization, and the subsequent evaluation of effectiveness and costs of the policy options. Technical, economic, and marketing data obtained with the cooperation of industrial groups, such as trade associations, permit an objective evaluation of policy impacts.

17028 (CONF-800483—(Vol.2), pp 796-798) **Energy-saving pumping systems in chemical plant design.** Reynolds, J.A. (Union Carbide Corp., South Charleston, WV). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The current cost of electrical power is translated into an annualized value to be used for economic considerations in the selection of pumping equipment. Motor-sizing guidelines are suggested to permit electric motors to operate nearer peak efficiencies. The need to provide adequate net positive suction head for centrifugal circulating pumps is illustrated. Situations are cited where variable-speed drivers can be employed advantageously. Margins of safety and control-valve pressure drops should be scrutinized.

17029 (CONF-800483—(Vol.2), pp 805-812) **US industrial energy consumption and conservation: past and future perspectives.** Ganeriwal, R. (Energy and Environmental Analysis, Inc., Arlington, VA); Ross, M.H. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

This paper examines US industrial energy consumption and conservation potentials by defining the concept of energy service which, in turn, leads to more-precise consideration of various aspects of energy conservation. It is seen that there are a number of components that contribute to energy conservation in the industrial sector. These consist of product and process change, energy-efficiency improvement and energy management. The total energy demand is projected on the basis of production indices, reduced (historical) energy-service requirements per unit of production, and estimates of efficiency improvements. The focus of this analysis is definition of the particular issues whose exploration would best improve the quality of projections of energy use. At the same time, a reasonable estimate of energy consumption for the industrial sector as a whole is obtained.

17030 (CONF-800483—(Vol.2), pp 813-819) **Industrial-conservation-technology energy-savings monitoring system.** Crowell, J.J.; Phipps, H.R. Jr. (Systems Consultants, Inc., Washington, DC). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

A system is described which monitors actual market penetration and energy savings of DOE-sponsored industrial conservation commercial technologies. The procedure to implement a new technology into the Impact Scoreboard System (ISS) is described. Included are examples of the implementation steps using two industrial-conservation technologies, a ceramic recuperator, and a textile foam-finishing technology. The paper concludes with a summary of the system benefits to government and industry.

17031 (CONF-800483—(Vol.2), pp 847-854) **Conservation: an in-plant energy resource.** Skudneski, L.A. (Bloom Engineering Co., Inc., Pittsburgh, PA). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Potential energy savings of 90 billion cubic feet of natural gas per year at existing facilities in basic steel alone are attainable through retrofitting and improvement in operations. Areas covered include reheat furnaces, soaking pits, cover annealing, and continuous- or batch-type heat treating. Improvements discussed include skid and support pipe insulation for underfired furnaces, positive and adequate controls, recuperation, and combustion equipment.

17032 (CONF-800483—(Vol.2), pp 855-861) **Ninety-two percent minimum heater efficiency by 1980.** Mieth, H.C. (Energy Tech., Inc., Houston, TX); Hardie, J.E. 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Technology is now available to increase heater efficiencies to 92% and more. By 1980, this technology will be field-proven and corrosion and reliability problems identified and resolved. Recent studies have shown that a minimum efficiency of 92% can be justified on heaters as small as 5 MMBtu/h with payouts below 3 years using $2.50/MMBtu fuel costs. Fuel costs continue to rise and many companies feel that $4 to $5 per MMBtu values are only a few years away.

17033 **(DOE/CS/40015—T2) Proposed industrial recovered materials utilization targets for the metals and metal-products industry.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1979. Contract AC03-78CS40015. 304p. NTIS, PC A14/MF A01.

The introductory chapter provides a discussion of the factors that affect the recovery and reuse of secondary materials and the competition between the primary and secondary metals industries. It discusses these industries in terms of resource characteristics, industry technology, pollution control requirements, market structure, the economics of recycling, and the issues involved in econometrically estimating scrap supply response behavior. It further presents the methodology established by DOE for the metals, textiles, rubber, and pulp and paper industries. The areas in which government policies might have a significant impact on the utilization of primary and secondary metals and on any recycling targets between now and 1987 are noted. Chapter 3 presents general profiles for the major industrial segments comprising SIC 33. The profiles include such topics as industry structure, process technology, materials and recycling flow, and future trends. Chapter 4 specifically covers the evaluation of recycling targets for the ferrous, aluminum, copper, zinc, and lead industries. (MCW)

17034 **(DOE/CS/40041—1) Slot Forge Furnace demonstration. Final report.** (Hague International, South Portland, ME (USA)). Feb 1981. Contract AC02-77CS40041. 14p. NTIS, PC A02/MF A01.

A Hague International Slot Forge Furnace was tested and installed to demonstrate a high performance energy conserving slot forge furnace in an industrial environment. This furnace was used to heat 2-1/2" round x 31-1/8" long bars in preparation for an upsetting operation. Each piece was heated twice, in separate operations, and upset on both ends. The Hague International Model IV Slot Forge Furnace used in the program was designed with a nominal throughput capacity of 3000 lbs/h. Due to production requirements the demonstration furnace was operated in the range of 3800 lbs/h. A base case furnace adjacent to the Hague furnace operated simultaneously. Fuel consumption and steel throughput data for both furnaces were collected and analyzed. A heating rate of 746 Btu/lb for the Hague furnace and 1620 Btu/lb for the base case furnace was demonstrated. Data demonstrated the Hague furnace's ability to save 54% of the fuel consumed by the base case furnace.

17035 **(DOE/CS/40092—T1) Optimization of energy usage in textile finishing operations. Part I. The simulation of batch dyehouse activities with a general purpose computer model.** Beard, J.N. Jr.; Rice, W.T. Jr. (Clemson Univ., SC (USA). Dept. of Chemical Engineering). 1980. Contract AS05-76CS40092. 210p. NTIS, PC A10/MF A01.

A project to develop a mathematical model capable of simulating the activities in a typical batch dyeing process in the textile industry is described. The model could be used to study the effects of changes in dye-house operations, and to determine effective guidelines for optimal dyehouse performance. The computer model is of a hypothetical dyehouse. The appendices contain a listing of the computer program, sample computer inputs and outputs, and instructions for using the model. (MCW)

17036 **(DOE/R5/10151—1) Reduction of energy usage in the Laundromat. Final report.** (EVNA Corp., Athens, OH (USA)). 1980. Contract FG02-79R510151. 14p. NTIS, PC A02/MF A01.

Retrofitting a laundromat to implement energy conservation is described. A network of water pipes was installed above the gas dryers to preheat the water before it goes into the gas water heater. Air recyclers for the stacks on the dryers were installed. A retrofit of commercially available pilot eliminators to the 22 dryers was accomplished by installing Ram pilot eliminators. Installation of a water saver system is description. Details of installing the high volume solar hot water system and results are described.

17037 **(PB—80-210743) Foreign industry energy effectiveness. Final report for 1979.** Fassbender, A.G.; Derouette, J.J.; Yanase, Y. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract GRI-5011-342-0154. 90p. NTIS, PC A05/MF A01.

The goal of this program is to identify, compare, and transfer European and Japanese gas energy efficient technologies to the U.S. The first phase of this program (1979-80) focused on identifying gas energy efficient foreign technologies that are not widely used in U.S. industry. Topics studied included gas energy technology in general, and specific gas energy applications in the metals, glass, ceramics, textiles, and food industries.

17038 **Statistical committee report of industry statistics for 1979.** Mirabella, A.C. (Hartford Steam Service Co., CT). pp 20, Section 6 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Data from the Statistical Committee of Industry Statistics for 1979 based on data received from 44 reporting utilities companies are reported. Of the reports received, 40 are from companies that reported in 1978, and 4 represent new companies. Summary data are included for: steam sold; spare capacity; generation; fuel used to produce steam; revenues; and chilled water sales. Data are shown on pictorial charts and in tables. (MCW)

17039 **Novel approach to field testing shunt-flow steam meters.** Steinmetz, G.F. (Baltimore Gas and Electric Co., MD). pp 27, Section 12 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

A means for field testing installed meters while in service is in the early stages of development at Baltimore Gas and Electric Company. Some design features and principles of shunt-flow meter operation are discussed. The calibration procedure and results to date are given. A discussion of the concept of field testing includes noting the potential benefits of the procedure.

17040 **Saving of energy when cooling milk and heating water on farms. Final report.** Ubbels, J.; Meulman, A.P.; Verheij, C.P.; Brouwer, J. Luxembourg; Commission of the European Communities (1980). 162p. (EUR—6915-EN).

The objective of this project is to present reliable methods and equipment to reduce the consumption of energy for the cooling of milk and the heating of water on farms. The introduction is follwed by a survey of systems which may be used; it illustrates the two lines along which the project is executed: (1) precooling the milk; and (2) using the condenser heat for the heating of water (refrigerated farm tank extended to heat pump). A description of the developed precooler is given. The experiments with ten such precoolers in operation at farms are described and results are given. The aim of a 50% energy saving was not realized. The amount of water used on farms for purposes directly related to the production of milk was established. The experiments with three types of heat pumps at the laboratory as well as at farms are described. The results are analyzed in detail. It appeared that water could be heated up to 60°C, and that the electrical energy consumed by the heat pump systems was the same or only slightly higher than that of the traditional farm tank. The aim of an energy saving of 50% could be realized easily.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 16603, 16720, 16792, 16897, 16975, 16999, 17038, 17039, 17233, 17362

17041 **(CONF-810343—1) Description of district heating: US history and current status.** Karnitz, M.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

From ASHRAE Richmond chapter conference; Richmond, VA, USA (18 Mar 1981).

The history of district heating includes both the birth of the district heating industry in the United States and the modern systems now being developed in northern Europe. During the early part of the twentieth century, the first small cogeneration/district heating plant came into existence. These systems used exhaust steam from small dual-purpose power plants to heat buildings in the nearby business district. As a result, steam district heating combined with cogeneration was widely accepted. During the late 1940s the situation changed when the introduction of inexpensive oil and natural gas for space heating reduced the rapid growth of district heating. Presently many US steam district heating businesses are not profitable and are in total disrepair. The history of district heating in Europe is somewhat different than that in the United States. The development of district heating networks in northern and eastern Europe started in the early 1950s. Hot water, rather than steam, was used as a transport media. European systems tend to have larger service areas than those in the United States. They serve lower heat load density regions and use remotely located cogeneration power plants.

17042 **(CONF-810435—1) Potential for district heating: an historical overview.** Broders, M.A. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From District heating technical training workshop; Washington, DC, USA (1 Apr 1981).

An introduction to district heating is outlined. Attention is focussed on the potential of district heating to meet the nation's energy conservation, environmental and social objectives. Basic terms are defined and the principal of district heating operation is described. District heating thermal energy sources, transport and distribution piping, and consumer secondary heating systems are discussed in very general terms. To gain a clearer understanding of the current status of district heating in the US today, a brief historical overview is presented. For comparison, the history and status of district heating in Europe are also summarized. The advantages of district heating are outlined, and the primary factors that impeded the implementation of district heating in the US are discussed.

17043 **(CONF-8003107—2) Energy issues relevant to domed cities, Winooski, Vermont: a case study.** Gant, R.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From International dome symposium; Winooski, VT, USA (27 Mar 1980).

Winooski, Vermont is typical of many small urban communities in the northeastern United States. The community's industrial base is declining and the residential/commercial building stock is aged and in general need of weatherization. Increasing fuel cost and uncertainty of supplies have prompted the community to seek alternative energy sources. Enclosing all or a significant portion of the community within a large secondary building envelope (dome) is perceived as a potential alternative energy strategy. The concept of secondary envelopes as a community level energy strategy was dis-

cussed. Five alternative energy strategies were presented which might be less costly and technically complex than an urban envelope. The alternatives focused upon local options and resources to affect reductions in total energy consumption and scarce fuels. Insulation and use of efficient appliances, hydroelectric development, installation of cogeneration/district heating systems, use of solar technologies, and combinations of technologies were discussed. The alternatives represent examples of the opportunities available to local governments to exercise a degree of control over the community's energy future.

17044 **(DOE/CS/20068—4) Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage I. Feasibility analysis. Final report. Volume 1.** (Georgetown Univ., Washington, DC (USA)). Oct 1980. Contract AC02-77CS20068. 331p. NTIS, PC A15/MF A01.

This Feasibility Analysis covers a wide range of studies and evaluations. The Report is divided into five parts. Section 1 contains all material relating to the Institutional Assessment including consideration of the requirements and position of the Potomac Electric Co. as they relate to cogeneration at Georgetown in parallel with the utility (Task 1). Sections 2 through 7 contain all technical information relating to the Alternative Subsystems Analysis (Task 4). This includes the energy demand profiles upon which the evaluations were based (Task 3). It further includes the results of the Life-Cycle-Cost Analyses (Task 5) which are developed in detail in the Appendix for evaluation in the Technical Report. Also included is the material relating to Incremental Savings and Optimization (Task 6) and the Conceptual Design for candidate alternate subsystems (Task 7). Section 8 contains all material relating to the Environmental Impact Assessment (Task 2). The Appendix contains supplementary material including the budget cost estimates used in the life-cycle-cost analyses, the basic assumptions upon which the life-cycle analyses were developed, and the detailed life-cycle-cost anlysis for each subsystem considered in detail.

17045 **(DOE/CS/20068—5) Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage II. Preliminary design. Final report.** (Georgetown Univ., Washington, DC (USA)). Nov 1980. Contract AC02-77CS20068. 263p. NTIS, PC A12/MF A01.

Results are presented for two elements in the Georgetown University ICES program - the installation of a 2500-kW backpressure steam-turbine generator within a new extension to the heating and cooling plant (cogeneration) and the provision of four additional ash silos for the university's atmospheric fluidized-bed boiler plant (added storage scheme). The preliminary design and supporting documentation for the work items and architectural drawings are presented. Section 1 discusses the basis for the report, followed by sections on: feasibility analysis update; preliminary design documents; instrumentation and testing; revised work management plan; and appendices including outline constructions, turbine-generator prepurchase specification, design calculations, cost estimates, and Potomac Electric Company data. (MCW)

17046 **Proceedings of the International District Heating Association. Volume 71.** Washington, DC; International District Heating Association (1980). 469p. (CONF-8006149—).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Separate abstracts are prepared for 20 papers presented at the conference.

17047 **Address at the IDHA conference.** McCarthy, W.J. Jr. (Detroit Edison Co., MI). pp 16, Section 3 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

The facilities, fuel, customers, demand factors, profitability, a proposed solid-waste fuel boiler, and government assistance concerning operation of a district heating system in downtown Detroit are discussed. Service to a group of industrial customers from the Delray electric power plant is briefly described. The current status of district heating nationally is descried as gathered from an ERI survey of 1979. Major factors that will impact district heating are seen as: reduction in the use of scarce fuels; energy conservation; environmental; incentives; fuel cost; risks; reliability; maintenance and replacement; planning; and institutional factors. (MCW)

17048 **Heatpumps in steam district heating.** Kurz, M.G. (Transflux International, Fort Lee, NJ). pp 15, Section 7 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

It is concluded that heat pumps in a steam district heating system provide opportunities for direct and indirect cost savings. The direct savings are derived from the less expensive heat provided by a heat pump rather than by the district heating system. What a heat pump can do, heating applications, air conditioning applications, and heat pumps as peak shavers are discussed. (MCW)

17049 **Piping networks for district heating applications.** Oliker, I.; Rubin, A.M. pp 25, Section 9 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

In order to assess the operational experience in district heating networks, forty district utilities located in the US, Europe, and Japan, with a total heat load of 18,000 MWT, have been surveyed. A summary of the results of the survey are presented. Although a substantial amount of information was assessed, conclusions very often could not be generalized since much of the information was related to a particular manufacturer and site. In addition to the survey, optimization of piping installation designs were performed employing a mixture of typical US and European district heating practices in order to reduce costs wherever possible, without jeopardizing overall system efficiency, reliability, or service life. The results of these analyses are described.

17050 **Operating policies, problems and experiences with the Helsinki energy supply system.** Kilpinen, U.; Rouhiainen, P. pp 42, Section 10 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

A district heating system was established in Helsinki in 1953 with combined generation of heat and electricity. Steam distribution for some industrial consumers was started already in 1952, and hot water district heating 1957. Cogeneration began in 1960. Summaries are presented on: national energy production; energy supply in Helsinki; development policies of the Helsinki Energy Board; structure of energy supply system in Helsinki (generating plants, heat distribution system); optimization of system operation; pricing, metering, and billing of heat; profitability of district heating and cogeneration. (MCW)

17051 **Licensing of district heating boilers: the Minnegasco Energy Center, Minneapolis, Minnesota experience.** Linwick, K.A. (Minnegasco Energy Center, Minneapolis, MN); Labno, B.A. pp 27, Section 11 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

The present Minnegasco Energy Center consists of two 200,000 lbs/h boilers and two standby plants with a firm capability of 450,000 lbs/h of steam. With increased development in downtown Minneapolis, an additional 200,000 lbs/h is needed. Initiation of the construction of the new unit requires proper approvals and permits, required by Federal law. A summary of these permits and the MEC's quest for permit approval is presented. Some general steps for moving toward obtaining an air quality permit are summarized. This also involves obtaining an exemption from the Power Plant and Industrial Fuel Use Act of 1978 to allow combustion of oil and gas. The status of the procedure is described. (MCW)

17052 **Hartford Steam Service Company: annual business report for 1979.** Mirabella, A.C. (Hartford Steam Service Company, CT). pp 7, Section 13 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

New business activities are reported by 40 steam systems. The number of new customers, estimated increases in steam consumption and revenue; also, the number of customers lost and revenue involved, the companies which can or cannot take on new business, and those planning expansion of their facilities are shown. In 22 cities, a total of 69 customers were added to district steam. The estimated steam consumption of new customers and customers who added load (16) is 1,563,566 M lb/y and the estimated annual revenue is $8,177,317. Of the new customers, 15.95 had used district steam before, 31.9% are in old buildings using district steam for the first time, and 52.5% are in new buildings. Sixteen existing customers in 9 cities added load. This additional load has an estimated annual consumption of 118,210 M lb. and revenue of $804,974, which amounts to approximately 9.8% of the total estimated new revenue. There were 117 customers in 22 cities who discontinued the use of district steam service, which is nearly 40% less than the previous year. Approximately 12% of the customers lost converted to oil, 75% converted to gas, 8% converted to electricity, and 5% converted to dual fuel (oil and gas). The total loss in revenue amounts to $1,942,623. New steam air conditioning installations for the year, as reported by five cities, amounted to 2483 tons. Steam capacity was increased in 1 city by 80,000 lb/h.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 17025

17053 (CONF-800483—(Vol.2), pp 739-746) **Oklahoma Industrial Energy Management Program.** Estes, C.B.; Turner, W.C. (Oklahoma State Univ., Stillwater). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The Oklahoma Department of Energy designed a program to acquaint Oklahoma industry with the potential savings available through energy management and some basic techniques. The program is entitled Oklahoma Industrial Energy Management Program and is housed at Oklahoma State University. This paper describes the program offerings, impact to date, and plans for the future.

17054 (CONF-800483—(Vol.2), pp 754-759) **Energy technical assistance: industrial processes program.** McClure, J.D. (Texas A & M Univ., Arlington). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

The Energy Technical Assistance Division of Texas Engineering Extension Service (TEEX) has implemented an energy-conservation program to assist small industry in using energy more efficiently. This full-time service, an outgrowth of the Texas A & M University College of Engineering activities, is available through support of Texas Energy and Natural Resources Advisory Council. Engineers with industry and consulting experience are located in Arlington and Houston TEEX offices.

17055 (CONF-800483—(Vol.2), pp 760-765) **Education and training promote energy conservation.** Steele, N.W. (Hercules Inc., Wilmington, DE). 1980.

From 2. annual conference on industrial energy conservation technology and exhibition; Houston, TX, USA (13 Apr 1980).

Significant progress has been made in reducing energy consumption via housekeeping, maintenance, procedural changes, and implementation of several hundred capital-related energy-conservation projects. Better understanding of utility operations by operators was gained through a formal training program. A comprehensive Distillation Training Program (DTP), consisting of videotapes and texts, was produced for training plant operators and supervisors. Justification for the DTP program was the total annual energy cost for distillation operations.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

17056 **(DOE/ET/13116—T13) Effects of microwaves on the performance of internal-combustion engines. Final technical report, September 30, 1979-January 31, 1981.** Ward, M.A.V. (Combustion Electromagnetics, Inc., Lexington, MA (USA)). 31 Jan 1981. Contract AC04-78ET13116. 73p. NTIS, PC A04/MF A01.

Progress is reported in a research program whose goals are to expand a date base on the electrical properties of hydrocarbon-air flames, to use the amplified data base to study the interaction of microwaves with the flame both in a combustion bomb and an appropriately designed single-cylinder test engine, and to apply high power microwave energy to the bomb and test engine in order to stimulate the combustion processes. Besides the work on the microwave/flame plasma properties, work was performed on the microwave properties of conventional and modified engine combustion chambers by means of an engine simulator. It was shown that conventional engine cylinders are unsuitable for storing microwaves and that they must be modified. Finally, the work on plasma jet ignition (as one ignition source for the microwave work), was continued. Information is presented on the microwave coupling system, high power microwave testing on a combustion bomb, and the fabrication of facilities for testing a single-cylinder test engine. It was demonstrated that the combined plasma jet/microwave system can be used to advantage to burn very lean mixtures and increase their flame speed. These improvements have been obtained in the limited environment of a combustion bomb. Much more work is necessary before these effects can be optimized and more thoroughly understood. The demonstrated ability to extend the lean flammability makes the task of further researching this work and then developing it almost a necessity. (LCL)

17057 **(DOE/ET/15397—T3) Technical progress report for application of numerical simulation methodology to automotive combustion.** (Science Applications, Inc., La Jolla, CA (USA)). Dec 1980. Contract AC04-79ET15397. 45p. NTIS, PC A03/MF A01.

The second quarterly technical progress report is presented for a program entitled, Application of Numerical Simulation Methodology to Automotive Combustion. The goal of the program is to develop, validate, demonstrate and apply a numerical simulation methodology for in-cylinder reactive flows in internal combustion engines. Previous work on this contract involved the initial development and validation of a finite difference based simulation model for time dependent axisymmetric flows which includes: a generalized coordinate system for arbitrary mesh design and treatment of complex and time dependent boundaries; multiple and interacting chemical species; coupled swirl flow velocity component; and two-equation turbulence closure. In its various stages of development, the model has been used to simulate numerous engine-related problems for validation and demonstration purposes. The technical effort during the current reporting period has concentrated on: reactive flow model development, test and data comparison studies; swirl flow simulations; and in-cylinder compression cycle flow simulations. Results of these studies are discussed.

17058 **(PB—80-209927) Evaluation of a Chrysler lean burn vehicle. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Oct 1975. 12p. NTIS, PC A02/MF A01.

Lean mixture combustion engines are attractive because of the low emissions and good fuel economy that are possible with a properly controlled lean burn engine. Chrysler Corporation has conducted research into engine operation at lean air-fuel ratios and is now planning to market lean burn vehicles. The U.S. Environmental Protection Agency's Emission Control Technology Division (ECTD) has tested several lean burn vehicles. However, none of these were full sized vehicles. Also none of the previous vehicles used systems that would possibly be marketed soon. ECTD requested a vehicle for testing. Chrysler Corporation made available a lean burn vehicle that ECTD was testing for sulfate emissions.

17059 **(PB—80-210305) Evaluation of the Ethyl lean reactor system applied to a Dodge Coronet. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Nov 1975. 14p. NTIS, PC A02/MF A01.

For many years, Ethyl Corporation engineers have conducted research into engine operation at lean air-fuel ratios. They were interested in lean-mixture combustion because of the inherently low emissions and good fuel economy that are possible without catalytic aftertreatment with a properly controlled lean engine. Some of their recent research efforts have been directed toward a demonstration of the potential of lean-mixture control techniques to meet emissions standards. The EPA's Emission Control Technology Division (ECTD) tested on Ethyl lean burn car equipped with a Turbulent Flow Manifold (TFM). The system was installed on a BMW 2002. This vehicle met the 1975 Federal emission standards and gave excellent fuel economy. Ethyl has done similar work on full-sized vehicles. They have achieved significant reductions in emissions on these vehicles and one vehicle has completed mileage accumulation. ECTD requested a vehicle for testing. Ethyl Corporation provided a Dodge Coronet equipped with their TFM induction system and exhaust aftertreatment.

17060 **(PB—80-210453) Exhaust emissions and fuel economy of three prototype Honda motorcycles. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Apr 1976. 20p. NTIS, PC A02/MF A01.

Early in 1976, the Honda Motor Company, Ltd., of Japan, offered to make available for EPA testing three prototype motorcycles designed to meet the proposed 1978 Federal emission standards for motorcycles. These motorcycles incorporated improvements in fuel metering and combustion control to reduce exhaust emissions, and improvements in durability to maintain the reduced exhaust emissions over the useful life of the vehicle. One motorcycle would be equipped with an auxiliary hydrocarbon control device in the exhaust system. Data supplied by Honda indicated that the prototype motorcycles would achieve the proposed 1978 standards with considerable improvement in fuel economy over that delivered by their current production motorcycles. The EPA agreed to test the three prototype motorcycles, and also requested that three current production motorcycles (which have uncontrolled exhaust emissions) be supplied with the prototype motorcycles so that comparisons between current production motorcycles and the prototype motorcycles could be made.

17061 **(PB—80-220759) Assessment of environmental impacts of light duty vehicle dieselization. Final report, May 1978-March 1979.** Forrest, L.; Lee, W.B.; Smalley, W.M. (Aerospace Corp., El Segundo, CA (USA)). Jun 1980. Contract DOT-TSC-1530. 345p. NTIS, PC A15/MF A01.

This report provides a first-level assessment of the environmental effects which might result if diesel vehicles in large numbers were produced and sold, thereby changing the mix of vehicles in the in-use fleet so that a substantial fraction were diesel-powered in future years. The study emphasizes the impacts of diesel exhaust emissions on air quality, especially particulates and odor. Impacts are projected to the year 2000, based on several selected scenarios for the growth in diesel population. Two types of air quality analyses are conducted; areawide and local site. The areawide analysis examines pollutant dump effects in three metropolitan city areas. The Local site analysis investigates pollutant concentrations in several critical urban sites: the heavily traveled freeway, the street canyon, and the enclosed parking garage. A general description of the methodology is provided. Results are presented in terms of trends in the emission inventories for the city-wide analysis and as pollutant concentration profile for the local site analysis. The areawide analysis indicates that dieselization would increase urban TSP by less than 3%, while air quality relative to HC, CO and NOx would improve. The local site analysis shows that dieselization would produce diesel particulate concentrations ranging from 9 to 13 micrograms/cubic meter at long term exposure locations in the freeway and street canyon sites and 24 micrograms/cubic meter in the enclosed parking garage. Odor effects in a nominal diesel-gasoline vehicle mix are found to be negligible.

17062 **(PB—80-224256) Assessment of diesel particulate control: particle size measurements. Final report, November 1978-November 1979.** McCain, J.D.; Faulkner, M.G. (Southern Research Inst., Birmingham, AL (USA)). Dec 1979. Contract EPA-68-02-2610. 26p. NTIS, PC A03/MF A01.

The report gives results of tests on an Oldsmobile 98 diesel automobile to obtain data on parameters typical of a light duty vehicle. Data are presented for operations under four simulated driving conditions. (The increasing appearance of the diesel engine on the passenger car market has led to concern over particulate emissions (smoke) from these engines. Possible control strategies involving particulate collection in the hot exhaust stream requires knowledge of the concentrations and size distributions of the particulate matter at exhaust conditions.)

3303 Electric-powered Systems

17063 **(ANL/OEPM—80-5) Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979.** Rajan, J.B. (comp.). (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 95p. NTIS, PC A05/MF A01.

The status and results through FY 1979 on the Near-Term Electric Vehicle Battery Project of the Argonne National Laboratory are summarized. This project conducts R and D on lead-acid, nickel/zinc and nickel/iron batteries with the objective of achieving commercialization in electric vehicles in the 1980's. Key results of the R and D indicate major technology advancements and achievement of most of FY 1979 performance goals. In the lead-acid system the specific energy was increased from less than 30 Wh/kg to over 40 Wh/kg at the C/3 rate; the peak power density improved from 70 W/kg to over 110 W/kg at the 50% state of charge; and over 200 deep-discharge cycle life demonstrated. In the nickel/iron system a specific energy of 48 Wh/kg was achieved; a peak power of about 100 W/kg demonstrated and a life of 36 cycles obtained. In the nickel/zinc system, specific energies of up to 64 Wh/kg were shown; peak powers of 133 W/kg obtained; and a life of up to 120 cycles measured. Future R and D will emphasize increased cycle life for nickel/zinc batteries and increased cycle life and specific energy for lead-acid and nickel/iron batteries. Testing of 145 cells was completed by NBTL. Cell evaluation included a full set of performance tests plus the application of a simulated power profile equivalent to the power demands of an electric vehicle in stop-start urban driving. Simplified test profiles which approximate electric vehicle demands are also described.

17064 **(BNL—51286) Fleet-Car Market PENetration Simulator: CPEN user's guide.** Weil, R. (Brookhaven National Lab., Upton, NY (USA)). Aug 1980. Contract AC02-76CH00016. 85p. NTIS, PC A05/MF A01.

The purpose of this manual is to assist prospective users in the understanding and execution of Fleet-Car Market PENetration Simulator (CPEN). CPEN is an interactive FORTRAN program whose purpose is to produce estimates of fleet-market-penetration rates of alternative passenger cars that can be described in terms of specific physical and economic attributes. The data were derived from questionnaires distributed to fleet operators affiliated with National Association of Fleet Administrators (NAFA). Besides the NAFA data, CPEN uses 48 variables that are interactively inserted. Complete data-input descriptions are included in the manual along with algorithm and application flowcharts. Examples of complete successful simulator runs are included for alternative program paths. A listing of the computer program and a glossary for CPEN are included.

17065 **(CONF-800523—4) DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments.** Yao, N.P.; Christianson, C.C.; Elliott, R.C.; Lee, T.S.; Miller, J.F. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 48p. NTIS, PC A03/MF A01.

From 3. international electric vehicle exposition and conference; St. Louis, MO, USA (May 1980).

From the inception of the DOE/ANL Near-Term eV Battery Program in 1978, significant progress in lead-acid, nickel/iron and nickel/zinc battery technology has been made towards achiev-

ing the technical performance goals necessary for widespread use of these battery systems in electric vehicle applications. The energy density of lead-acid eV batteries has advanced from 25 to 30 Wh/kg to over 40 Wh/kg. The prospect for obtaining a lead-acid battery having both high energy density and long cycle life in a few years is very promising. Nickel/iron modules have demonstrated a specific energy of nearly 50 Wh/kg and a specific power of 100 W/kg, cycle lives of 300 have been achieved during early 1980 and testing continues, and the energy efficiency has been improved from less than 50% to over 65%. Nickel/zinc module test data have shown a specific energy of nearly 70 Wh/kg and a specific power of 130 W/kg. However, cycle life improvements are still needed. Cost reduction continues to receive major emphasis at developers of both nickel/zinc and nickel/iron batteries. Based on the continued demonstration of viable solutions to technical problems in the 1980 to 1983 time-frame, these near-term batteries will emerge as contenders for electric vehicle applications. The relative cost/performance/life tradeoff of these battery systems continues to receive emphasis in the DOE/ANL R and D Program. While it would be premature at the present time to select winning systems or specific technical approaches, it is the intent of the DOE/ANL program management to continue supporting the development of the most viable approaches in response to the 1986 commercialization goal.

17066 **(DOE/CS—0026/13) Electric and hybrid vehicle program. Quarterly report, October-November-December 1980.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Feb 1981. 29p. NTIS, PC A03/MF A01.

Recent research activities on development and commercialization of electric vehicles and hybrid electric vehicles is briefly summarized. More extensive information is provided on: the status of hybrid vehicle development contracts; the results of a heuristic model that ranks cities according to their potential for generating EV markets; testing of the Eagle-Picher nickel-iron battery; the test results, advantages, and costs of electronic commutation of permanent magnet motors; the annual market demonstration site operators meeting; and the certification and testing status of demonstration project vehicles. (LCL)

17067 **(DOE/CS—0130/4) Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Jan 1981. 132p. NTIS, PC A07/MF A01.

This fourth annual report on the implementation of the Electric and Hybrid Vehicle Research, Development and Demonstration Act of 1976 (Public Law 94-413, as amended by Public Law 95-238, referred to as the Act) complies with the reporting requirements established in Section 14 of the Act. In addition to informing the Congress of the progress and plans of the Department's Electric and Hybrid Vehicle Program, this report is intended to serve as a communication link between the Department and all of the public and private interests involved in making the program a success. During FY 1980, significant progress was made toward implementing the policies established by Congress in the Act. There has been a noticeable increase in interest shown by both the market and the supply segments of our economy in electric and hybrid vehicles. The demonstration site operators have increased in number to 68 with demonstration sites located in 94 cities across the Nation. Loan guarantees were awarded to two electric vehicle manufacturers. Research and development efforts in batteries and propulsion components, as well as total vehicle systems, continue to reveal significant progress toward providing industry with technology options that will result in vehicles with greater public acceptance. The second electric test vehicle (ETV-2) developed under the DOE EHV Program was delivered. This year, the EHV Program was restructured into five specific projects that are formulated to enhance the research, development, and demonstration of electric and hybrid vehicles leading to their expeditious introduction into the Nation's transportation fleet to reduce our dependence on petroleum.

17068 **(DOE/CS/54209—T1) Electric and hybrid vehicles charge efficiency tests of ESB EV-106 lead-acid batteries.** Rowlette, J.J. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Jan 1981. Contract AI01-78CS54209. 152p. (JPL-PUB—80-94). NTIS, PC A08/MF A01.

Charge efficiencies were determined for ESB EV-106 lead-acid batteries by measurements made under widely differing conditions of temperature, charge procedure, and battery age. The measurements were used to optimize charge procedures and to evaluate the concept of a modified, coulometric state-of-charge indicator. Charge efficiency determinations were made by measuring gassing rates and oxygen fractions. A novel, positive displacement gas flow meter which proved to be both simple and highly accurate is described and illustrated.

17069 **(DOE/NASA/51044—17) Advanced continuously variable transmissions for electric and hybrid vehicles.** Loewenthal, S.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1980. Contract AI01-77CS51044. 29p. (NASA-TM—81718; CONF-801242—6). NTIS, PC A03/MF A01.

From Electric and hybrid vehicle advanced technology seminar; Pasadena, CA, USA (8 Dec 1980).

A brief survey of past and present continuously variable transmissions (CVT) which are potentially suitable for application with electric and hybrid vehicles is presented. Discussion of general transmission requirements and benefits attainable with a CVT for electric vehicle use is given. The arrangement and function of several specific CVT concepts are cited along with their current developmental status. Lastly, the results of preliminary design studies conducted under a NASA contract for DOE on four CVT concepts for use in advanced electric vehicles are reviewed.

17070 **(PB—80-212020) FMVSS (Federal Motor Vehicle Safety Standard) 212/219/301 testing of electric vehicles - Electra Van 600, EVA Pacer. Final report.** Yee, R. (Dynamic Science, Inc., Phoenix, AZ (USA)). Aug 1979. Contract DOT-HS-5-01104. 179p. NTIS, PC A09/MF A01.

This report presents the results of two electric vehicle-to-NHTSA Fixed Test Device head-on crash tests. These tests were conducted to determine if the vehicles would comply with the fuel spillage requirements of Federal Motor Vehicle Safety Standards (FMVSS) 301, Fuel System Integrity, the windshield retention requirements of FMVSS 212, and the windshield zone intrusion requirements of FMVSS 219. The standard fixed barrier was replaced by the 40-load cell NHTSA Fixed Test Device. The electric vehicles tested in this report were: Electra Van 600, manufactured by Jet Industries, Inc., Austin, Texas and EVA Pacer, manufactured by Electric Vehicle Associates, Cleveland, Ohio. The Electra Van 600 was tested on June 13, 1979, at a speed of 30.34 mph, with the following results: (a) FMVSS 212 - 100% retention failure, (b) FMVSS 219 - inconclusive due to FMVSS 212 failure, (c) FMVSS 301 - 16.7 oz measured in 5 minutes, estimated 7 gallons lost during 90 degrees rollover. The EVA Pacer was tested June 14, 1979, at a speed of 30.53 mph, with the following results: (a) FMVSS 212 - 2.5 in. of windshield separation, (b) FMVSS 219 - 9/16 in. into lower right corner of windshield protected zone by hood corner, (c) FMVSS 301 - 0.33 oz collected transimpact, 27 oz during 90 degrees rollover. Tank completely drained after 180 degrees roll. Small fire occurred immediately after impact.

17071 **(UCRL—84445) Estimates of the cost and energy consumption of aluminum-air electric vehicles.** Cooper, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1980. Contract W-7405-ENG-48. 85p. (CONF-8010159—1). NTIS, PC A05/MF A01.

From Fall meeting of the Electrochemical Society; Hollywood, FL, USA (5 Oct 1980).

Economic costs and primary energy consumption are estimated for general purpose electric vehicles using aluminum-air propulsion batteries within the time frame of the 1990's (earliest possible date of introduction). Critical assumptions are given. The results show that, for a 40 kW, 70 kWh battery used in a vehicle traveling 16,000 km/y, the total capital investment in electricity and aluminum production plants and fuels distribution system was $2250 or $32/kWh. Of this, the aluminum plants contributed 60%, and the

fuels distribution system, 3% (less than $1/kWh). The introduction of 1,000,000 vehicles per year in 1995 would increase domestic aluminum demand by below 5% per year, and electricity demand by less than 0.2% per year.

17072 **(UCRL—85390) Advanced vehicle of the DOE electric and hybrid vehicle program.** O'Connell, L.G. (Lawrence Livermore National Lab., CA (USA)). Dec 1980. Contract W-7405-ENG-48. 37p. (CONF-801242—5). NTIS, PC A03/MF A01.

From Electric and hybrid vehicle advanced technology seminar; Pasadena, CA, USA (8 Dec 1980).

The performance requirements for and the technical or economic barriers which must be overcome in the development and production of advanced electric vehicles (EV) or hybrid-electric vehicles are discussed. The technologies compared include EV's using battery exchange, hybrid EV's using batteries and a small heat engine, roadway-powered EV's, EV's with aluminum-air batteries, and EV's with fuel cells. (LCL)

17073 **(UCRL—85425) Roadway powered electric vehicle (RPEV) system concept description and project overview.** Davis, D.D.; Walter, C.E. (Lawrence Livermore National Lab., CA (USA)). Dec 1980. Contract W-7405-ENG-48. 15p. (CONF-801242—4). NTIS, PC A02/MF A01.

From Electric and hybrid vehicle advanced technology seminar; Pasadena, CA, USA (8 Dec 1980).

The program at Lawrence Livermore National Laboratory for evaluating the practicality of roadway-powered electric vehicles, and the design and construction of laboratory and roadway facilities for testing these vehicles are discussed. (LCL)

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 17064, 17066, 17067, 17068, 17069

3305 Flywheel Propulsion

REFER ALSO TO CITATION(S) 16878

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 17069

17074 **Design for fuel economy: the General Motors X cars.** Warrendale, PA; Society of Automotive Engineers, Inc. (1980). 121p. (SAE/SP—80/452).

Eight papers on engineering aspects of the design of the General Motors family of 1980 X cars are presented. A separate abstract of each paper was prepared for the Energy Data Base (EDB) but not for Energy Abstracts for Policy Analysis (EAPA). (LCL)

3307 Emission Control

REFER ALSO TO CITATION(S) 17058, 17059, 17060, 17061, 17062, 17360

17075 **(PB—80-209877) Emission laboratory correlation study between EPA and the Japan Automobile Manufacturers Association, Inc. Technical report.** Lowery, R.E. (Environmental Protection Agency, Ann Arbor, MI (USA). Emission Control Technology Div.). Apr 1974. 54p. NTIS, PC A04/MF A01.

This report presents the results of an extensive correlation study between EPA and the Japan Automobile Manufacturers Association, Inc. (JAMA). It specifically compares the test facilities of Nissan and Toyota to EPA's Ann Arbor Laboratory. No significant differences were discovered between the Toyota and EPA laboratories. Emission levels produced by vehicles tested at both laboratories were very similar. Significant differences in emission levels of vehicles tested at both Nissan and EPA laboratories were experienced. Vehicle variability appeared to be a major cause of the discrepancies.

3308 Alternative Fuels

17076 **(P—500-81-007) Senate Bill 620: alcohol fuels program.** (California Energy Commission, Sacramento (USA). Synthetic Fuels Office). Jan 1981. 55p. California Energy Commission, Sacramento.

Senate Bill 620 (Mills), Statutes of 1979, appropriates $10 million to the California Business and Transportation Agency to undertake a program to investigate the practicality and cost effectiveness of alternative motor vehicle fuels. The California Energy Commission assumed responsibility for two alcohol fuels programs - the Ethanol Production Demonstration Program and the Alcohol Fleet Test Program. The Ethanol Production Demonstration Program explores the practicality, energy efficiency, and cost effectiveness of using biomass to produce fuel grade ethanol in commercial-scale plants. The Energy Commission has funded several projects. Five received funds for feasibility analysis, and two received funds for final design and construction. The projected level of ethanol production from these demonstration projects is 25.0 to 33.5 million gallons per year or 363,775 barrels of crude oil equivalent per year. The second aspect of the Alcohol Fuels Program is the Alcohol Fleet Test Program. The purpose of Fleet One is to demonstrate the use of methanol and ethanol fuels in existing vehicles which have been retrofitted to accommodate alcohol fuels. The purpose of Fleet Two is to develop, test, and demonstrate methanol- and ethanol-fueled factory-produced vehicles which meet established emission standards, fuel economy, and performance criteria. The purpose of Fleet Three is to develop, test, and demonstrate factory designed passenger vehicles which meet future emission, fuel economy, and performance requirements with neat methanol fuel. As part of the Fleet One and Two tests, a major oil company (Conoco/Douglas) will establish at its own expense two alcohol fuel handling and dispensing stations, one in Sacramento and one in Vallejo. As part of the Fleet Three test, a number of these fueling sites will be established. One will be paid for with Fleet Three funds, and Conoco/Douglas will establish two or more sites at its own expense.

36 MATERIALS

REFER ALSO TO CITATION(S) 17747

17077 **(SAND—81-0570C) Commercial applications of overlay coating techniques.** Mattox, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 9p. (CONF-810425—1). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Francisco, CA, USA (6 Apr 1981).

A coating may be defined as a near-surface region that has properties which differ from those of the bulk of the material. This separation of surface properties from the bulk properties allows a design, engineering and fabrication flexibility which is often desirable and sometimes necessary to produce an economically useful product. Coatings may be fabricated in a number of ways and some of the important techniques are presented. The fabrication techniques may be generally catagorized as one which form overlay coatings where the surface region is composed of a material which differs from the bulk material and fabrication techniques which form coatings by surface modification processes where some of the bulk material is detectable in the coating.

17078 **(UCRL—84843) New photographic technique for observing bulk laser damage.** Sonderman, J.; Stokowski, S.; Thomas, N.; Wallerstein, P.; Walmer, D. (Lawrence Livermore National Lab., CA (USA)). 30 Jan 1981. Contract W-7405-ENG-48. 19p. (CONF-8009119—3). NTIS, PC A02/MF A01.

From 12. annual symposium on optical materials for high power lasers; Boulder, CO, USA (Sep 1980).

A damage site camera was developed to record the onset of bulk laser damage in materials. The camera images and magnifies the damage track using forward-scattered laser light. Employing this camera we can detect the presence of very small (10 m) damage sites with densities as low as 10/cc. The camera is used at

oblique incidence to the part being tested. We have observed discrete damage sites generated within the bulk of some materials, such as silicate glass, fluorophosphate glass, and KDP crystals, by 1-ns 1064-nm laser pulses. The energy fluxes at which bulk damage is initiated are in the range of 2 to 20 J/cm², much lower than the fluxes required to cause damage by intrinsic processes. Small foreign inclusions (1 m diameter) are the cause of these low bulk damage thresholds. The inclusions density varies from 10^7/cc to less than 10/cc. At threshold the damaged volumes are small (1 to 5 min diameter) and thus, can be observed most easily by their forward-scattered light. Several photographs are shown to illustrate the onset of bulk laser damage in fluorophosphate glass and KDP crystals.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 16358, 16365, 16366, 16367, 16379, 16382, 16406, 16573, 16599, 16600, 16601, 16719, 16795, 16833, 16840, 16843, 16843, 16849, 17135, 17242, 17579, 17683, 17690, 17746, 17750, 17754, 17832, 17832

17079 (BNL—29256) Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors. Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 8p. (CONF-810340—2). NTIS, PC A02/MF A01.

From 7. international conference on magnet technology; Karlsrube, F.R. Germany (30 Mar 1981).

Since the discovery of the bronze process for fabrication of multifilamentary Nb_3Sn and V_3Ga composite wires, significant progress has been made in the production of commercial-scale conductors with these compounds. However, improvements in the values of the critical-current density J/sub c/* (the matrix and the superconductors) of these wires are desired and appear possible for high-magnetic-field applications. In this section, an attempt is made to assess the value of the current density which could be achieved in the future in multifilamentary Nb_3Sn and V_3Ga at magnetic fields above 10 tesla. In order to do this, promising superconducting properties of experimental wires at high fields are summarized, and based on these values, achievable J/sub c/* in multifilamentary Nb_3Sn and V_3GA wires are estimated. In the process, some suggestions for approaches to improve J/sub c/* are discussed.

17080 (CONF-800730—4) Atom-probe investigation of a micro-crack associated with hydrogen in a Fe-Ti alloy. Kuk, Y.; Sakurai, T.; Pickering, H.W. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AC02-79ER10430. 7p. NTIS, PC A02/MF A01.

From 27. international field emission symposium; Tokyo, Japan (7 Jul 1980).

We have for the first time witnessed the formation of a micro-crack and its development into a fracture using field ion microscopy. The crack initiated at a grain boundary intersection and propagated mainly, though not entirely, along the grain boundary. Compositional analysis at a hydrogen-produced micro-crack in a Fe-0.29 wt % Ti alloy by the high-performance time-of-fight atom-probe showed a large amount of hydrogen at the crack (H and H_3) and iron-hydrides (FeH, FeH_3). In contrast, hydrogen in any form is rarely found in other surface areas, or in the bulk.

17081 (CONF-800730—5) Cluster formation and the elevated temperature strengthening of iron alloys by Ti. Pickering, H.W.; Kuk, Y.; Sakurai, T. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AC02-79ER10430. 9p. NTIS, PC A02/MF A01.

From 27. international field emission symposium; Tokyo, Japan (7 Jul 1980).

A compositional analysis of a Fe-Ti alloy was carried out using a time-of-flight atom-probe. In the subsurface atom-layer region, Ti was found to be present as randomly distributed titanium atoms and to a lesser degree as clusters of Ti around impurities, such as C, N and O. The titanium is also strongly segregated to the surface and grain boundaries. The titanium profile at the surface extends over 20 atom distances into the bulk. In contrast oxygen, which also segregates and combines to form mainly TiO and TiO_2, is confined to a few atom layers of the surface. This direct observation of clustering supports a strengthening mechanism proposed by Cuddy and co-workers to explain anomolous mechanical property data observed at somewhat elevated temperatures in Ti-bearing iron alloys.

17082 (CONF-800730—6) Phosphorus segregation to grain boundaries in a Fe-0.04% P alloy. Sakurai, T.; Kuk, Y.; Grabke, H.J.; Birchenall, A.K.; Pickering, H.W. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AC02-79ER10430. 7p. NTIS, PC A02/MF A01.

From 27. international field emission symposium; Tokyo, Japan (7 Jul 1980).

Grain boundaries were successfully observed in a Fe-0.04%P alloy using a field ion microscope (FIM), and the composition along a grain boundary was analyzed using a high-performance time-of-flight atom-probe. Phosphorus was found to segregate to the grain boundaries below 600°C, in agreement with the previous Auger electron spectroscopy studies.

17083 (DOE/CS/40153—T1) Kinetics of the desulfurization of molten iron. Final report. Gaskell, D.R. (Pennsylvania Univ., Philadelphia (USA)). Mar 1981. Contract AS02-78CS40153. 17p. NTIS, PC A02/MF A01.

Experimental work has involved the fabrication of impervious slip-cast CaO crucibles, measurement of the rate of desulfurization of liquid iron by solid CaO and measurement of the rate of desulfurization of liquid iron by CaO-saturated liquid FeO. Above $0.087 < \text{wt \% S} < 0.67$, the activity of FeS is high enough to form a liquid phase in the system CaO-Fe-S. With lower sulfur levels, CaO does not cause any desulfurization of the liquid iron. When CaO-saturated liquid FeO is brought into contact with a liquid Fe-S alloy a rapid initial rate of desulfurization occurs due to surface tension-induced local convection at the slag-metal interface. After this initial period, the rate of desulfurization is determined by diffusion of sulfur in the metal. No change occurs in the oxygen content of the metal during desulfurization and hence the half cell reactions occurring in the electrochemical transfer process are $[Fe] \rightarrow (Fe^{2+}) + 2e^-$ and $[S] + 2e^- \rightarrow (S^{2-})$. Addition of CaF_2 to the CaO-saturated slag has no effect on the desulfurization.

17084 (DOE/ER—0045/5) Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 279p. NTIS, PC A13/MF A01.

Progress is reported in eight sections: analysis and evaluation studies, test matrices and test methods development, Path A Alloy Development (austenitic stainless steels), Path C Alloy Development (Ti and V alloys), Path D Alloy Development (Fe alloys), Path E Alloy Development (ferritic steels), irradiation experiments and materials inventory, and materials compatibility and hydrogen permeation studies. (DLC)

17085 (DOE/ER/01198—1343) Study of diffusion of oxygen in dilute vanadium alloys using solid electrolytic cells. de Avillez, R.; Altstetter, C. (Illinois Univ., Urbana (USA)). 1981. Contract AC02-76ER01198. 14p. (CONF-810203—9). NTIS, PC A02/MF A01.

From AIME annual meeting; Chicago, IL, USA (22 Feb 1981).

The bulk diffusivity of oxygen has been measured as a function of temperature in dilute vanadium alloys. The emf vs time is measured on the electrolytic cell: $Pt/Nb+NbO/ThO_2\text{-}7\%Y_2O_3/V\text{-alloy}/Zr/Pt$. The oxygen content, which is initially uniform in the vanadium-based alloy, drains into the zirconium sink as a function of annealing time. After a short transient, the rate of cell emf change is directly proportional to the diffusivity of oxygen in the alloy. Substitutional solutes in vanadium have been chosen on the basis of their atomic sizes in vanadium and the heats of formation of their oxides. Oxygen diffusion results have been obtained for nickel, chromium, niobium, tantalum, titanium, zirconium and hafnium as binary solute additions of up to 4 at. %. The oxygen diffusivity results are compared with those for niobium-based alloys. Interpretations of the results are made using two models for the thermodynamics and kinetics of trapping of interstitial atoms by substitutional solute atoms.

17086 **(DOE/ER/02313—T1) Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980.** Olson, D.L.; Matlock, D.K. (Colorado School of Mines, Golden (USA)). 1980. Contract AS02-76ER02313. 62p. NTIS, PC A04/MF A01.

Fatigue crack growth has been used to evaluate the interaction between liquid lithium and an imposed stress. Fatigue crack growth data on type 304L stainless steel at 700C and 2 1/4Cr-1Mo steel between 500 and 700C show that for all imposed test conditions (i.e. frequency, temperature, and nitrogen content in the lithium) the interaction of lithium with the strain at the crack tip results in enhanced crack growth rates. The enhanced growth rates result from the effects of either enhanced grain boundary penetration or a change in crack propagation mechanism due to liquid metal embrittlement. Auger spectroscopy of grain boundary penetrated specimen shows that a lithium-oxygen compound forms at the grain boundary. Moessbauer evaluations of the ferrite layer of corroded type 304 stainless steel are being used to develop a model for weight loss in liquid lithium. The welding research in progress is directed to characterize the influence of variations of the austenitic weld metal composition on the microstructural and mechanical properties of dissimilar metal weldments. Weldments of 2 1/4Cr-1Mo steel to 316 stainless steel have been investigated for fusion microstructure, thermal expansion impact strength and characterization of specific long time in-service failures. Modification of weld metal microstructures by microalloy additions is being investigated as a concept to improve weld metal properties. The behavior of a strip electrode in a gas metal arc is being investigated to determine the feasibility of gas metal arc weld strip overlay cladding.

17087 **(DOE/ER/02462—T1) Localized corrosion and stress-corrosion cracking behavior of stainless steel weldments. Annual progress report, June 1, 1980-February 28, 1981.** Savage, W.F.; Duquette, D.J. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). Feb 1980. Contract AS02-76ER02462. 44p. NTIS, PC A03/MF A01.

Pitting corrosion experiments were conducted on 308L stainless steel as a function of alloy microstructure (% delta ferrite) in acidified water-methanol solutions. Slow strain rate stress corrosion cracking studies were performed on single-phase and duplex 304 stainless steels as functions of solution chemistry, temperature, and sensitization. (DLC)

17088 **(DOE/ER/04799—2) Basic study of heat flow in fusion welding. Progress report, March 1, 1980-February 28, 1981.** Szekely, J.; Eagar, T.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1981. Contract AS02-78ER04799. 10p. NTIS, PC A02/MF A01.

During the past year the study of electroslag welding was essentially completed with good agreement between the experimental and the theoretical results. It is concluded that the ESW process has certain inherent limitations which were not appreciated previously. The study has expanded into a more complete analysis of heat and fluid flow in arc welding. It has been shown that the heat affected zone and fusion zone sizes are not simple functions of the net heat input as predicted by all current theories. This will affect the choice of welding parameters. For example, in single pass arc welds, the smallest HAZ is usually desirable, while in multipass welding large HAZ's may be desirable to provide tempering of the previous weld beads. It may be possible to achieve both these goals at equivalent heat input by proper adjustment of the welding parameters (such as voltage, current and travel speed). Goal of the current study is to predict which combinations of parameters maximize or minimize the size of the heat affected zone and fusion zone at equal heat input.

17089 **(DOE/ER/04993—T1) Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981.** Butt, J.B.; Schwartz, L.H. (Northwestern Univ., Evanston, IL (USA)). Apr 1981. Contract AC02-78ER04993. 13p. NTIS, PC A02/MF A01.

The past year has seen completion of two major tasks in the research program: (1) a detailed study of the characterization of particle size in supported α-Fe_2O_3 and related characterizations of the reduced metal with silica gel support; (2) a reaction study of a series of silica supported Fe-Ni, Fe-Co, Fe-Cu, Fe-K and the corresponding pure metals. Synthesis activity and selectivity were particular objectives of this work, and a particular correlation of the conversion dependence of selectivity and water-gas shift activity was observed. We feel this to be an important finding: the catalysts which are good water-gas shift catalysts are the ones which are inhibited during the synthesis. A mechanism of product inhibition by water formation has been proposed to explain the conversion dependence of selectivity.

17090 **(DOE/ER/05002—15) Computer simulation study of the structure of vacancies in grain boundaries.** Brokman, A.; Bristowe, P.D.; Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). Jan 1981. Contract AS02-78ER05002. 40p. NTIS, PC A03/MF A01.

The structure of vacancies in grain boundaries has been investigated by computer molecular statics employing pairwise potentials. In order to gain an impression of the vacancy structures which may occur generally, a number of variables was investigated including: metal type, boundary type, degree of lattice coincidence and choice of boundary site. In all cases the vacancies remained as distinguishable point defects in the relatively irregular boundary structures. However, it was found that the vacancy often induced relatively large atomic displacements in the core of the boundary. These displacements often occurred only in the direct vicinity of the vacancy, but in certain cases they were widely distributed in the boundary, sometimes at surprisingly large distances.

17091 **(DOE/ER/10429—T2) Atomistic studies of grain boundaries with segregated impurities. Progress report, July 1, 1980-June 30, 1981.** Vitek, V. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). Feb 1981. Contract AS02-79ER10429. 17p. NTIS, PC A02/MF A01.

The aim of this research project is to carry out atomistic studies of grain boundaries with impurities. The emphasis of the investigation is on the effect of segregation upon the structure of grain boundaries and their properties. Since the necessary precursor of any atomistic study is a description of interatomic interactions an empirical scheme for the construction of interatomic potentials was first developed. In this scheme which was summarized in a previous report, the interatomic interactions are described by pair potentials together with a volume dependent term which represents a major contribution to the overall energy of the studied system. A new relaxation method had to be developed that includes the volume dependent term into the calculations which are then carried out at constant pressure rather than at constant volume. Furthermore, this method also inlcudes the possibility of dealing with spatially varying concentration of impurities. It is described in more detail in the report.

17092 **(DOE/ER/10430—8) Atomic-scale observation of hydrogen-induced crack growth by atom-probe FIM.** Kuk, Y.; Pickering, H.W.; Sakurai, T. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AC02-79ER10430. 3p. (CONF-8010159—2). NTIS, PC A02/MF A01.

From Fall meeting of the Electrochemical Society; Hollywood, FL, USA (5 Oct 1980).

Formation and propagation of a microcrack due to hydrogen in a Fe-0.29 wt.% Ti alloy was observed at the atomic scale by field ion microscopy. A microcrack (-20 nm in length) formed and became noticeably large when the tip was heated at 950°C in the presence of about 1 torr of Hg. Propagation was reported several times by reheating, until a portion of the tip ruptured and became detached from the tip. Compositional analysis, performed in situ using a high performance atom-probe, identified atomic hydrogen in quantity and some hydrogen molecules and FEH in the crack, but not elsewhere on the surface.

17093 **(DOE/ER/10430—9) Observation of grain boundary segregation on an atomic scale in a Fe-0.04% P alloy by atom-probe FIM.** Sakurai, T.; Kuk, Y.; Grabke, H.J.; Birchenall, A.K.; Pickering, H.W. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AC02-79ER10430. 4p. (CONF-8010159—3). NTIS, PC A02/MF A01.

From Fall meeting of the Electrochemical Society; Hollywood, FL, USA (5 Oct 1980).

Grain boundaries introduced intentionally in a Fe-0.04% P alloy by cold-working were successfully observed using a field ion microscope (FIM), and the composition along a grain boundary was analyzed using a high-performance time-of-flight atom-probe. Phosphorus was found to segregate to the grain boundaries below 600°C, in agreement with previous Auger electron spectroscopy studies. In addition to P, it was found that several other elements, such as Ti, O, C and Mn segregate to the grain boundaries at different annealing temperatures.

17094 **(DOE/ER/10430—T1) Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981.** Sakurai, T.; Pickering, H.W. (Pennsylvania State Univ., University Park (USA)). Jan 1981. Contract AC02-79ER10430. 11p. NTIS, PC A02/MF A01.

Progress in several areas is summarized: (1) compositional analysis of Ti clusters and H associated microcrack formation in Fe-Ti alloys, (2) grain boundary segregation of phosphorus in a Fe-0.04%P alloy, (3) surface segregation of Cu in Ni-Cr alloys. In addition to these achievements, the construction of a new atom-probe is under way, although some delay is anticipated before its completion.

17095 **(DOE/ER/10433—2) Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II.** Gerberich, W.W. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). 1 Apr 1981. Contract AS02-79ER10433. 36p. NTIS, PC A03/MF A01.

Objectives are to understand the roles of alloy additions, grain size and yield strength on fatigue threshold and near-threshold growth rates for selected bcc materials. Thus far, a predictive model for burst cleavage in Fe-binary alloys has been derived and verified. A predictive model for cyclic strain hardening exponents of an HSLA steel at low temperatures has been derived and verified. A proposed model for cyclic cleavage crack extension in terms of geometrically necessary dislocations has been partially investigated. Experimentally, grain size and low temperature effects on thresholds and crack growth of HSLA steels and Ti-30 Mo have been nearly completed and similar studies on Fe-binary alloys are in progress. With such input, models are currently being developed for prediction of microstructural effects on threshold and near-threshold crack growth under mixed mode conditions.

17096 **(DOE/ER/10450—1) Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980.** Oriani, R.A. (Minnesota Univ., Minneapolis (USA)). 30 Jan 1981. Contract AC02-79ER10450. 171p. NTIS, PC A08/MF A01.

At present, the research ranges from the quantum mechanics of the corrosion unit reactions, organic and inorganic coatings, surface reactions on polymers, metals and semiconductors to high-temperature chemistry of interest to solar-energy conversion. A second objective of the Center is to increase the utilization of corrosion data by the technical community through education and through the dissemination of appropriately formatted information. At present, two projects are in the planning stage for the near future. One is a pedagogical symposium on corrosion in microelectronic components and systems; the other is a series of lectures and videotapes, as well as a workshop on cathodic protection.

17097 **(DOE/ET/10404—2) Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report.** Rapp, R.A. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). Feb 1981. Contract AC02-79ER10404. 51p. NTIS, PC A04/MF A01.

Research was conducted on the sulfidation of pure Mo by sulfur gases at 700 to 950°C and on the in-situ oxidation of metals and alloys in the hot-stage SEM. Results on the in-situ oxidation of Cu, Ni, Fe, and Cu-6% Ni up to 930°C are reported in detail. 21 figures.

17098 **(DOE/ET/13513—T8) Contract WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9, second annual report, January 1-December 31, 1980.** Shaw, B.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). 20 Jan 1981. Contract AC05-78ET13513. 44p. NTIS, PC A03/MF A01.

The hydrogen embrittlement susceptibility of commercial 2-1/4 Cr-1Mo steels has been investigated, using H_2S as the primary environment. After it was found that low strength steels, which had been given a post weld heat treatment, were immune to the test techniques developed, the effect of strength level was studied to establish a lower limit for embrittlement. Similar tests on the peak hardness zone in the heat affected zone of a weld showed that the crack preferred to move to the far heat affected zone where the strength level was below the lower limit established above. It is suggested that residual stresses may account for the anomaly, although other factors such as structural change could be important. In order to assess the low strengh steels, the environment was changed to include saturated water vapor in the H_2S. It was found that the low strength steels could be readily tested in this environment, thus providing a means of ranking Cr-Mo steels for hydrogen embrittlement susceptibility. Tests on one steel were included to show that the variability in the data using the $H_2S + H_2O$ environment was small enough to make the screening test results significant.

17099 **(DOE/ET/13513—T9) WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9. Second annual report, January 1-December 31, 1980.** Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 20 Jan 1981. Contract AC05-78ET13513. 44p. NTIS, PC A03/MF A01.

The hydrogen embrittlement susceptibility of commercial 2 1/4Cr - 1Mo steels has been investigated, using H_2S as the primary environment. After it was found that low strength steels, which had been given a post weld heat treatment, were immune to the test techniques developed, the effect of strength level was studied to establish a lower limit for embrittlement. Similar tests on the peak hardness zone in the heat affected zone of a weld showed that the crack preferred to move to the far heat affected zone where the strength level was below the lower limit established above. It is suggested that residual stresses may account for the anomaly, although other factors such as structural change could be important. In order to assess the low strength steels, the environment was changed to include saturated water vapor in the H_2S.

17100 **(HEDL-SA—1936) Impact of advanced microstructural characterization techniques on modeling and analysis of radiation damage.** Garner, F.A.; Odette, G.R. (Hanford Engineering Development Lab., Richland, WA (USA); California Univ., Santa Barbara (USA)). 1980. Contract AC14-76FF02170. 18p. NTIS, PC A02/MF A01.

The evolution of radiation-induced alterations of dimensional and mechanical properties has been shown to be a direct and often predictable consequence of radiation-induced microstructural changes. Recent advances in understanding of the nature and role of each microstructural component in determining the property of interest has led to a reappraisal of the type and priority of data needed for further model development. This paper presents an overview of the types of modeling and analysis activities in progress, the insights that prompted these activities, and specific examples of successful and ongoing efforts. A review is presented of some problem areas that in the authors' opinion are not yet receiving sufficient attention and which may benefit from the application of advanced techniques of microstructural characterization. Guidelines based on experience gained in previous studies are also provided for acquisition of data in a form most applicable to modeling needs.

17101 **(Juel-Spez—52) Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing.** Pietz, S. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung). Aug 1979. 97p. (In German). NTIS (US Sales Only), PC A05/MF A01.

Several FeTi-alloys with Mn-, C-, Al-, 0-additives and $LaNi_5$ were loaded with hydrogen. The loading kinetics was investigated as a function of the temperature, of hydrogen gas pressure, of the grain size distribution and partially also in a mixture with FeTi and $LaNi_5$. The aim of the investigation was to get a deeper knowledge on the initial loading process (activation) to ensure the technical application of these alloys as hydrogen storage materials.

17102 **(LA-UR—81-747) Improved aluminum coatings for the ultraviolet.** Edwards, D.F.; LaDelfe, P.; Ochoa, E. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 14p. (CONF-810429—4). NTIS, PC A02/MF A01.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

Highly reflective aluminum coatings or aluminum coatings with dielectric overcoats are frequently used in the ultraviolet. The reflectance values published by Hass and his group are generally accepted for this uv region. We have produced evaporated aluminum coatings for a wide range of deposition conditions and none of our coatings exhibit the Hass reflectance characteristics. The reflectance of our coatings appear to be independent of the evaporation pressure and deposition time or rate. Our coatings do not have the characteristic decrease in reflectance with decreasing wavelength. Our main attention has been focused on the origin of a reflectance dip for each of our coatings near 300 nm. This dip has apparently not been reported before and does not appear to be due to adsorbed layers on the film or due to trapped impurities within the film.

17103 **(LBL—10639) Study of precipitate morphology by consideration of elastic strain energy.** Wedge, D.E. (Lawrence Berkeley Lab., CA (USA)). Dec 1980. Contract W-7405-ENG-48. 60p. NTIS, PC A04/MF A01.

A formulation given by A.G. Khachaturyan for the elastic strain energy of a coherent second phase inclusion of arbitrary shape in an elastically anisotropic medium is used to calculate numerically the elastic energy for three different shapes - disk, lens, and ellipsoid - of α'' ($Fe_{16}N_2$) particles in the Fe-N system, as a function of the particle aspect ratio. The results of the calculation are used to compute values for an isotropic interface energy γ, using experimental reports of particle dimensions. Two other elastic energy models are also used to compute γ, one from an analytical approximation by Khachaturyan, and one from the work of J.D. Eshelby. All these models are also used in conjunction with an anisotropic interface energy model to calculate values for the habit plane interface energy γ/sub H/. The vaues for the interface energy are found to be much more consistent with the theory when the anisotropic model is used.

17104 **(PB—80-212202) Materials studies for superconducting machinery coil composites. Interim report.** Ekin, J.W.; Kasen, M.B.; Read, D.T.; Schramm, R.E.; Tobler, R.L. (National Engineering Lab. (NBS), Washington, DC (USA)). Nov 1979. 163p. NTIS, PC A08/MF A01.

The physical properties of a superconducting coil composite are studied to accurately predict the coil behavior under operating conditions. Emphasized in this third interim report are studies on the effect of stress and strain on the critical current of superconducting wires. The report also includes data on several fiberglass/epoxy support structures for the coil and its dewar. Preliminary results are also given for the effect of stress on small superconducting composite rings used to model the full sized coil behavior. A summary of the program results to date is included.

17105 **(PB—80-815210) Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 258p. NTIS PC N01/MF N01.

The Federally-sponsored research reports cited deal with the development of techniques and procedures for inert gas welding and with the characteristics of the resulting welds. Process control, automation, nondestructive testing, and health hazards are also investigated. Metals welded include steel, titanium, aluminum, uranium, and refractory metals. (This updated bibliography contains 229 citations, 26 of which are new entries to the previous edition.)

17106 **(PB—80-815244) Titanium and titanium alloy creep. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Sep 1980. 211p. NTIS PC N01/MF N01.

Research is cited on creep of titanium and its alloys with regard to composition, stress corrosion, fatigue, fracture, and microstructure. Tests are described on varying conditions of temperatures, pressures, and atmospheres. Processing and metalworking are covered for their relationship to creep resistance. Many reports deal with applications to aircraft, spacecraft, and nuclear reactors. (This updated bibliography contains 206 citations, 12 of which are new entries to the previous edition.)

17107 **(RFP—3195) Burrs formed in producing small holes.** Burnham, M.W. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group). 1981. Contract AC04-76DP03533. 11p. (CONF-810427—1). NTIS, PC A02/MF A01.

From SME international tool and manufacturing engineering conference and exposition; Detroit, MI, USA (27 Apr 1981).

Several cases in which residual material must be removed from parts containing small holes are discussed. It is concluded that in many cases no burr removal technique is acceptable, and deburring should not be attempted. (HDR)

17108 **(SAND—80-2431C) Thermal-fatigue testing of coatings for fusion-reactor applications.** Mullendore, A.W.; Whitley, J.B.; Mattox, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 13p. (CONF-810425—5). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Francisco, CA, USA (6 Apr 1981).

Thermal fatigue testing has been performed on eight coated or clad materials which have potential application as limiters in pulsed tokamak fusion devices. They are chemical vapor deposited (CVD) coatings of TiC, TiB_2 and B on graphite, plasma sprayed TiB_2 on Cu, a chemical conversion coating of VB_2 on V clad Cu, Ti clad Cu and V clad Cu. Testing consisted of up to 1000 cycles of electron beam heating for 1.5 sec. at beam power densities of 1 and 2 kW/cm^2. Three materials, CVD TiC and TiB_2 on graphite and plasma sprayed TiB_2 on Cu survived the 1000 cycle, 2 kW/cm^2 test with slight but acceptable damage. The most notable test failure was VB_2 on V clad Cu which deformed severely by a thermal ratcheting mechanism and displayed subsurface melting.

17109 **(UCRL—15332) X-ray diffraction study of residual stress in model weldments. Final report.** Stroud, R.D.; Shackelford, J.F. (California Univ., Davis (USA). Dept. of Mechanical Engineering). Nov 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

Residual stress in a model weldment in nickel plate was characterized using x-ray diffraction techniques. The stress was mapped in 2 mm divisions up to the boundary of the weld pool. Results were in generally good agreement with the stress levels previously predicted for this system by finite element studies at LLNL. Recommendations are made that would permit 1 mm^2 spatial resolution maps of residual stress in stainless steel weldments.

17110 **Interpretation of differential reflectance studies of metal surfaces.** Feibelman, P.J. (Sandia Labs., Albuquerque, NM). *Physical Review* [*Section*] *B: Condensed Matter ;* **23**: No. 6, 2629-2634(15 Mar 1981).

Formulas are derived which relate differential surface power absorption spectra for s- and p-polarized light to differential reflectance data, frequency by frequency. The formulas, which are exact for jellium, do not involve the use of Fresnel equations or any theoretically calculated parameters.

17111 **Magnetization of compositionally modulated CuNi films.** Zheng, J.Q.; Falco, C.M.; Ketterson, J.B.; Schuller, I.K. (Argonne National Laboratory, Argonne, Illinois 60439). W-31-109-ENG-38. *Applied Physics Letters ;* **38**: No. 6, 424-426(15 Mar 1981).

We report static magnetization measurements on the compositionally modulated ferromagnetic alloy Cu/Ni, which, contrary to earlier ferromagnetic resonance measurements, show the moment per Ni atom is reduced relative to pure Ni. The low-temperature magnetization is found to vary linearly with modulation amplitude, but, surprisingly, the Curie temperature is found to be almost amplitude independent.

17112 **Fermi-surface measurements of mixed-valent $CeSn_3$.** Johanson, W.R.; Crabtree, G.W.; Edelstein, A.S.; McMasters, O.D. (Argonne National Lab., IL). Contract W-7405-ENG-82. *Physical Review Letters ;* **46**: No. 7, 504-507(16 Feb 1981).

The first measurements of Fermi-surface properties in a mixed-valent metal using the de Haas—van Alphen effect are presented. At least nine separate frequency branches in $CeSn_3$ are seen and have measured effective masses as large as 9.2. The experiments show that hybridization between the conduction states and local f states occurs coherently in the mixed-valence compound $CeSn_3$, resulting in Bloch states with well-defined wave vector and energy.

17113 **Comparison of steady-state and second-sound measurements of the Kapitza resistance.** Katerberg, J.A.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois). DE-AC02-76ER01198. *Journal of Low Temperature Physics ;* **42**: No. 1, 165-176(1 Jan 1981).

The Kapitza thermal boundary resistance R/sub k/ has been measured using both the steady-state (dc) and the second-second (ac) techniques on the same copper sample during the same low-temperature run. The two techniques give the same values of R/sub K/; R/sub K/ is therefore a constant for measuring frequencies ranging from dc to 600 Hz. We could not reproduce the strong temperature dependence of R/sub K/ observed in earlier ac measurements unless both second-sound resonators were thermally coupled to the superfluid helium bath.

17114 **(NE-M—7-7T(Rev.)(1-81)) Cobalt-chromium alloy bars and shapes.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jan 1981. 10p. Nuclear Standards Management Center, Oak Ridge, TN.

This standard covers hot rolled and solution annealed and hot rolled, solution annealed, and aged cobalt-chromium alloy bars in the shape of rounds, squares, hexagons, and hollow cylinders for wear and corrosion resisting applications in nuclear plant and associated systems. Material purchased to this standard is intended for non-tensile load bearing applications.

17115 **Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors.** Ulrickson, M.; Cecchi, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Thin Solid Films ;* **73**: No. 1, 133-138(3 Nov 1980).

From International conference on metallurgical coatings; San Diego, CA, USA (21 - 25 Apr 1980).

As the input power to tokamaks has increased in each generation of machines, the need for careful selection of the material to be used as the primary heat sink has become more acute. The impurity control part of the tokamak fusion test reactor flexibility modification program has supported research to control impurities through proper material selection. Testing of selected coatings and claddings is being carried out to determine suitable candidates. At this point in the study the most interesting material choices are a TiC coating on Poco graphite and a vanadium cladding on copper.

17116 **(UCRL—15318) Metallurgical study for University of California Lawrence Livermore Labs.** (Hexcel MCI Div., Montebello, CA (USA)). [nd]. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01.

Characteristics of several braze alloys (AMI-915, AMS-4772, AMI-935, AMI-937, BNI-6, BAG-18, etc.) were evaluated. Combinations of 304 SS and 21-6-9 were fabricated into T-sections. Lap shear tests and composite coupon tests were also made. Results indicate that AMS-4772, AMI-935, and AMI-915 should provide acceptable mitigator brazes. Suitable brazes can be performed in either vacuum or hydrogen without affecting the strength at the braze joint. (DLC)

17117 **(DOE/ER/10428—2) Protective oxide films. Progress report.** MacCrone, R.K.; Shatynski, S.R. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). [nd]. Contract AS02-79ER10428. 10p. NTIS, PC A02/MF A01.

Resistance relaxation, thermogravimetry, transport, and EPR were used to study the growth of protective NiO films on nickel. (DLC)

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 16365, 16370, 16552, 16571, 16571, 16942, 16944, 16946, 17096, 17167, 17890

17118 **(DOE/DP/40095—T1) Glassy thin films. Final report.** Haller, W.; Sanders, D.M.; Farabaugh, E.N. (National Bureau of Standards, Washington, DC (USA)). 27 Jan 1981. Contract AI08-79DP40095. 13p. NTIS, PC A02/MF A01.

This report describes the initial results of a long term program to study order-disorder phenomena in dielectric thin films. To achieve this overall goal, an apparatus was constructed to permit the codeposition of a glass-forming additive such as SiO_2 in a polycrystalline matrix film such as MgO. The extent of crystallinity of mixture films in the $MgO\text{-}SiO_2$ system was determined using techniques developed for x-ray powder diffraction. With this approach, it was determined that the addition of SiO_2 in concentrations less than 20 mass % has a relatively small influence on crystallinity. On the other hand, at concentrations greater than 25% SiO_2 causes the mixture film to become completely disordered.

17119 **(DOE/ER/02923—4) High-temperature properties and processes in ceramics: thermomigration. Annual report, January 1, 1980-December 31, 1980.** Wuensch, B.J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1980. Contract AS02-76ER02923. 19p. NTIS, PC A02/MF A01.

Information is presented concerning pore migration in KCl crystals in a temperature gradient; thermomigration of electronic defects and vacancies in FeO; time-dependent thermomigration; influence of transmutation on radiotracer diffusion; study of local electrochemical equilibrium; and short-circuit diffusion paths.

17120 **(DOE/ER/04441—4) Inelastic deformation in crystalline non-metallic materials. Progress report.** Kohlstedt, D.L. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Feb 1981. Contract AS02-77ER04441. 49p. NTIS, PC A03/MF A01.

Samples of much higher density than those produced by sintering have now been prepared by hot-pressing TiC + Ti below the solidus temperature. These results are described briefly. A hand-written, first draft of a paper on hot-pressing in the system TiC-VC-Ti-V elaborates on processing of (Ti,V)C samples to be used in creep experiments this next year.

17121 **(DOE/ER/10382—2) Study of local atomic and electronic structure in glassy metallic alloys. Progress report, December 1, 1979-November 1, 1980.** Messmer, R.P.; Wong, J. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 1980. Contract AC02-79ER10382. 18p. NTIS, PC A02/MF A01.

During the first reporting period, March 1, 1979-December 1, 1979, small clusters such as Fe_4, Ni_4, Ni_2Fe_2 alone and containing the metalloid atoms P and B were investigated. The effect of P and B on the magnetic moment of the clusters was investigated and found to parallel the known experimental trend. Significant metal-

metalloid bonding was found in all the clusters studied. During the present reporting period a detailed analysis of the bonding in these small clusters was carried out. As a result of this detailed analysis a very significant conclusion has been reached: there are preferential metal-metalloid interactions which are predicted on the basis of the calculations. Room temperature extended x-ray absorption fine structure (EXAFS) spectra above the K absorption edge of metal constituents in the following metal-metalloid and metal-metal glasses have been measured in the February and June 1980 runs at Stanford Synchrotron Radiation Laboratory: Fe/sub 1-x/B/sub x/, (FeNi)/sub 1-x/B/sub x/, Ni/sub 1-x/B/sub x/; Zr/sub 1-x/M/sub x/ (M- Fe, Co, Ni and Cu) and Nb/sub 1-x/Ni/sub x/.

17122 **(DOE/ER/10430—7) High-performance atom-probe field ion microscope study of segregation and hydrogen cracking in Fe-0.29 Ti.** Kuk, Y.; Pickering, H.W.; Sakurai, T. (Pennsylvania State Univ., University Park (USA)). 1980. Contract AC02-79ER10430. 9p. (CONF-800850—5). NTIS, PC A02/MF A01.

From International conference on effects of hydrogen on materials; Jackson Lake Lodge, WY, USA (26 Aug 1980).

With the greatly improved resolution now available in energy focused atom probes, hydrogen can be readily resolved even when combined with metals having several isotopes. In addition to finding that H, H_2, FeH and TiH_2 accumulate at segregated grain boundaries in Fe-0.29 wt % Ti, a striking observation was made - the formation and propagation of a microcrack when the (field ion microscope) tip was exposed to hydrogen gas at elevated temperature. A small crack (~ 200 A in length) was first noticed at a grain-boundary intersection during field ion imaging. This was an open crack, formed by detachment of metal between the intersecting grain boundaries, which was observed to be much larger after the tip was reheated to 1300°K for 10 min. in the presence of 10^2 Pa (1 torr) H_2. This crack could be easily reduced in size by gradually field evaporating the surface. Its propagation was repeated several times and reproducible results were obtained. Hydrogen was identified in quantity in the crack surface, though not elsewhere. The observation of H_2 is taken to mean that H_2 gas was trapped in the grain boundary. The grain boundary was also observed to be enriched in Ti, O, C and S, in agreement with earlier results for Fe-Ti.

17123 **(DOE/ER/10453—2) Properties of glasses with high water content. Progress report, 1 March 1980-31 January 1981.** Tomozawa, M.; Watson, E.B. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jan 1981. Contract AC02-79ER10453. 11p. NTIS, PC A02/MF A01.

Glasses with high water content were prepared by a hydrothermal process and various properties were measured. The following unique features have been revealed: (1) electrical conductivity decreases substantially at first with the addition of water and then increases with the further addition of water. The phenomenon is somewhat similar to the mixed alkali effect; (2) the glass with higher water content is radiation coloration resistant; (3) with the addition of water, glasses became tougher at room temperature, suggesting the occurrence of plastic deformation.

17124 **(SAND—80-2613C) Phosphate glass ceramics: formation, properties, and applications.** Wilder, J.A. Jr.; Healey, J.T.; Bunker, B.C. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 32p. (CONF-810528—1). NTIS, PC A03/MF A01.

From 83. symposium on nucleation and crystallization in glasses; Washington, DC, USA (3 May 1981).

Several glasses in the Na_2O-CaO-P_2O_5, Na_2O-BaO-P_2O_5, Na_2O-Al_2O_3-P_2O_5, and Li_2O-BaO-P_2O_5 systems devitrified to form glass ceramics upon heat treatment. One mol % of TiO_2, ZrO_2, Y_2O_3, La_2O_3, Ta_2O_5, as nucleating agents included in a 39 Na_2O.10 BaO.50P_2O_5.1 nucleating agent (mol %) glass caused a larger volume of crystal phases to form compared to the undoped glass. Grain sizes generally increased with field strength of nucleation cation.

17125 **(SAND—81-0063C) Applications of scanning electron microscopy to failure analysis in ceramics and glasses.** Mecholsky, J.J.; Healey, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 32p. (CONF-810410—2). NTIS, PC A03/MF A01.

From Scanning electron microscopy conference; Dallas, TX, USA (14 Apr 1981).

Scanning electron microscope techniques using secondary and backscattered electron images have been applied to the fracture surface analysis of brittle materials. The principles of fracture mechanics and fracture surface analysis have been combined to understand fracture of several glasses and ceramics including: optical fibers, solar mirrors, turbine blade and infrared transmitting dome materials. The scanning electron microscope has unique capabilities for detecting extremely small fracture origins, defining phase differences and identifying inhomogeneities and inclusions. We developed a new backscatter technique which reveals the microstructures directly from the fracture surface, thereby eliminating the necessity for polishing and etching the surface which destroys fracture surface information.

17126 **Electronic structure of the rotation twin stacking fault in β-ZnS.** Northrup, J.E.; Cohen, M.L. (Univ. of California, Berkeley). *Physical Review [Section] B: Condensed Matter ;* **23**: No. 6, 2563-2566(15 Mar 1981).

The electronic structure of the rotation twin stacking fault in β-ZnS is calculated with the self-consistent pseudopotential method. The stacking fault creates a potential barrier of ~0.07 eV and induces the localization of stacking-fault resonances near the top of the valence band. Stacking-fault states are also predicted to exist in the various gaps in the projected valence-band structure.

17127 **Temperature dependence of the spin dynamics of EuO.** Mook, H.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Physical Review Letters ;* **46**: No. 7, 508-511(16 Feb 1981).

Neutron-inelastic-scattering techniques have been used to study the spin dynamics of EuO. High-quality single crystals were used so that temperature-dependent line shapes could be obtained at all momentum values. It was found that the magnetic excitations above T/sub c/ changed from Lorentzian-like peaks centered at zero energy near the zone center to rather well defined spin-wave-like excitations at the zone boundary.

17128 **Ferromagnetism in the $RERh_4B_4$ compounds.** MacKay, H.B.; Woolf, L.D.; Maple, M.B.; Johnston, D.C. (Univ. of California, San Diego, La Jolla). Contract EY-76-S-03-0034-PAZZ7-3. *Journal of Low Temperature Physics ;* **41**: No. 5/6, 639-651(1 Dec 1980).

The magnetic ordering temperatures of the primitive tetragonal rare earth (RE) rhodium boride compounds exhibit a peak at $DyRh_4B_4$ rather than $GdRh_4B_4$ as predicted from ordering via the indirect RKKY exchange interaction. This deviation is analyzed in terms of the depression of the superconducting transition temperature of $LuRh_4B_4$ by dilute amounts of RE impurity ions and the magnetic heat capacities of the $RERh_4B_4$ compounds for RE = Gd, Tb, Dy, and Ho. The strength of anisotropic crystalline electric field forces, as inferred from magnetic entropy considerations, may be the origin of the anomalous magnetic ordering temperatures. In addition, the depression of the superconducting transition temperatures of $ErRh_4B_4$ and $TmRh_4B_4$ from that of $LuRh_4B_4$ is shown to arise primarily from elastic exchange scattering of the conduction electrons by the magnetic RE ions.

3603 Composite Materials

REFER ALSO TO CITATION(S) 16721, 16721

17129 **Thermal conductivity and specific heat of a glass—epoxy composite at temperatures below 4 K.** Walker, F.J.; Anderson, A.C. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). DE-AC02-76ER01198. *Review of Scientific Instruments, The ;* **52**: No. 3, 471-472(Mar 1981).

The thermal conductivity and specific heat of the glass—cloth reinforced epoxy laminate G-10, as well as the cryogenic grade G-10 CR, have been measured over the temperature range 0.1—4 K.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 16722, 16877, 17096

17130 **(DOE/ER/10421—T1) Effects of processing conditions on the reliability of cross-linked polyethylene cable insulation. Progress report.** Phillips, P.J. (Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering). 1 Mar 1981. Contract AS02-79ER10421. 20p. NTIS, PC A02/MF A01.

Crystallization and morphology were investigated in cross-linked PE. ^{13}C NMR was used to quantify the cross-links. Production of cable is being studied. Dielectric constant and loss of cross-linked PE are being measured. (DLC)

17131 **(SAND—81-0806C) Hydrocarbon plasma emission as a means to monitor plasma polymerization.** Bieg, K.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 18p. (CONF-810425—3). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Francisco, CA, USA (6 Apr 1981).

A diagnostic feature of the optical emission from a toluene glow discharge is the relative intensities of the aromatic benzl radical V spectrum band and the aliphatic CH $A^2\Delta$ - $X^2\pi$ band system. Evaluation of the relative intensities of these emissions allows a prediction of the chemical structural characteristics of the deposited polymer film independent of reactor power level, pressure, or flow rate.

17132 **(UCRL—53105) Effect of vinyl and phenyl contents of silicone gum on the properties of the elastomers and cellular silicone cushions.** Cady, W.E.; Jessup, E.S.; Buckner, A.T. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 2 Dec 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

Two series of random terpolymers of dimethyl-diphenyl-methylvinylsiloxane were synthesized. In one series, the amount of methylvinylsiloxane was varied from 0 to 5 wt % and diphenylsiloxane was maintained at a nominal 12 wt %. In the other series, diphenylsiloxane was varied from 0 to 18 wt % and methylvinylsiloxane was maintained at a nominal 1 wt %. Molecular weights were maintained around 500,000. These gums were filled with about 26 wt % silicon dioxide and then converted to the intermediate elastomers, temporarily filled molding compounds, and cellular silicone cushions. The intermediate elastomers and cellular silicones were cured with a vinyl specific catalyst and tested. Increasing vinyl content increases the stiffness of the cushion but decreases its resiliency. Compression set reaches a minimum of about 5% at a methylvinylsiloxane content of about 0.9 wt %. Phenyl content has only a slight effect on cushion properties. Compression set is a minimum in a range of 7 to 14 wt % diphenylsiloxane.

17133 **(UCRL—84039) Application of structure-property relationships to develop seven segmented polyurethane adhesives.** Hoffman, D.M.; Hammon, H.G.; Althouse, L.P. (Lawrence Livermore National Lab., CA (USA)). 1981. Contract W-7405-ENG-48. 22p. (CONF-810506—1). NTIS, PC A02/MF A01.

From 39. Society of Plastics Engineers annual technical conference; Boston, MA, USA (4 May 1981).

Seven polyurethane adhesives have been developed to meet a series of design requirements for weapons. These adhesives, designated Halthanes, were synthesized because of OSHA restrictions on the use of the curing agent methylene bis(2- chloroaniline) with the objective of meeting qualitative design requirements. Four of the Halthanes were made from LLNL-developed 4,4'-methylene bis(phenylisocyanate) terminated prepolymers cured with a blend of polyols; three were made from an LLNL-developed prepolymer terminated with Hylene W and cured with aromatic diamines. Changes in the structure of prepolymer, curing agent and accelerator were made to achieve initial viscosities in the range of 6 and 40 Pa-sec, and working times of from 4 to 24 hours. The structure of the polymer/substrate interface was used to obtain adhesive strengths of from 8 to 14 MPa at room temperature. The morphology and concentration of the hard and soft segments were used to control the modulus and elasticity of these segmented polyurethanes. Seven polyurethane adhesives have been developed that bond rapidly and well, have low to intermediate modulus over a wide temperature range, and appear to be reasonably compatible with other components.

17134 **Annealing of polypropylene films crystallized from a highly extended melt.** Schultz, J.M. (Oak Ridge National Lab., TN); Lin, J.S.; Hendricks, R.W.; Petermann, J.; Gohil, R.M. Contract W-7405-ENG-26. *Journal of Polymer Science, Polymer Physics Edition ;* **19**: No. 4, 609-620(Apr 1981).

Thin films of isotactic polypropylene were drawn from the melt at a very high rate of extension. Transmission electron micrographs of this material reveal fibrous crystals lying along the draw direction. The chain axis and fiber axis are identical. Dark-field micrographs show a dark/light modulation along the fiber axis. Annealing at temperatures below 110°C produces no qualitative change in the electron microscope observations. Annealing between 110 and 150°C produces gradual dominance of lamellar crystals, oriented normal to the draw direction. Small-angle x-ray scattering (SAXS) data exhibit a strong streaking normal to the fiber axis, in broad agreement with the observed fibrosity. A Bragg peak along the draw directions shows that the modulation observed microscopically is a density modulation. The absence of second-order maxima and the dependence of the SAXS peak on treatment temperature strongly suggest that the axial modulation is a spinodal decomposition of the material into crystalline and amorphous regions.

17135 **Effect of composition and neutron irradiation on the upper critical field of Nb_3Pt.** Lambert, S.E.; Maple, M.B.; Sweedler, A.R.; Moehlecke, S. (Univ. of California, San Diego, La Jolla). Contract EY-76-S-03-0034-PA227-3;EY-76-C-02-0016. *Journal of Low Temperature Physics ;* **41**: No. 5/6, 653-665(1 Dec 1980).

The upper critical field H/sub c/2(T) of the A15 compound Nb/sub 100-x/Pt/sub x/(19< or = x < or = 29.1) has been measured as a function of temperature T for various compositions and levels of irradiation with fast reactor neutrons. Compositions ranging from 19 to 29 at. % Pt and neutron fluences up to 16 x 10^{18} n/cm^2 (E > 1 Me V) were studied. A stoichiometric sample that had been rapidly quenched from the liquid (splat-cooled) was also investigated. For the unirradiated samples, T/sub c/ exhibits a maximum of 10.4 K at the stoichiometric composition, while both H/sub c/2(0) and dH/sub c/2(T)/dT/sub T/ = T/sub c/ attain their maximum values on the Pt-rich side of stoichiometry. The irradiated samples show a decrease of H/sub c/2(0) with increasing neutron fluence. The results are discussed in terms of antisite disorder and a strong correlation is obtained between decreasing H/sub c/2(0) and increasing disorder of the Nb atomic sites.

3606 Other Materials

REFER ALSO TO CITATION(S) 16641, 16642, 16643, 16646, 16647, 16655, 16660, 16662, 16680, 16680, 16680, 16836, 17096

17136 **(BDX—613-2553) Low-temperature curing of a nitrile-epoxy adhesive. Final report.** Tira, J.S. (Bendix Corp., Kansas City, MO (USA)). Apr 1981. Contract AC04-76DP00613. 21p. NTIS, PC A02/MF A01.

Adhesive strength and glass transition temperature were correlated with cure times at 85°C and above. The effect of moisture on adhesive cure and strength was tested. With a 3-hour cure at 85°C, lap shear strength met specification requirements. The adhesive was found to absorb moisture with time, especially if one or both polyethylene covers are removed. Placing the adhesive in a desiccator for 30 minutes produced excellent room temperature shear strengths. Preconditioning (removal of moisture) is critical for elevated temperature cures.

17137 **(BNL—29161) Optical emission studies of reactive species in plasma deposition.** Kampas, F.J.; Griffith, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 6p. (CONF-810331—2). NTIS, PC A02/MF A01.

From Conference on tetrahedrally bonded amorphous semiconductors; Carefree, AZ, USA (12 Mar 1981).

Optical emission studies of the glow-discharge deposition of a-Si:H alloys reveal the presence of reactive species derived from process gases and impurities. Studies of the dependences of emission intensities upon deposition parameters elucidate the mechanisms of formation of these species. Effects of impurities detected by emission spectroscopy upon a-Si:H film electronic properties are discussed. A model of the chemical reactions involved in film growth is presented.

17138 **(DOE/DP/40013—1) CO_2 laser absorption and saturation studies of molecular impurities in alkali halide crystals.** Sievers, A.J. (Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics). Dec 1980. Contract AS08-78DP40013. 45p. NTIS, PC A03/MF A01.

The objective of this research program has been to explore the equilibrium and non-equilibrium dynamical properties of ReO_4^- molecules embedded in alkali halide lattices using electromagnetic radiation. Both incoherent sources and CO_2 laser radiation have been used to explore the full dynamic range of the molecular vibrational modes. To achieve this objective stable molecular dopant - alkali halide combinations have been fabricated which have vibrational modes near the CO_2 laser frequencies. In order to uncouple the molecular modes from the lattice modes, to simplify the analysis as much as possible, low temperature spectroscopic measurements were required. In general, it was found that the molecular vibrational modes in the low temperature quiescent lattice had extremely narrow linewidths (less than 0.1 cm^{-1}) so that most of the coincidences with the CO_2 laser lines were eliminated.

17139 **(DOE/ER/01885—T1) Liquid-phase-sintering phenomena of non-oxide silicon compounds. Technical progress report, 1 July 1979-29 February 1980.** Clarke, D.R.; Lange, F.F. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Mar 1980. Contract AC03-78ER01885. 50p. NTIS, PC A03/MF A01.

The noncrystalline intergranular phase in three hot-pressed silicon nitride alloys containing MgO has been found to have a composition close to the SiO_2-Mg_2SiO_3 tie line. This finding of a composition removed from the ternary eutectic in the Si_3N_4-Si_3N_2O-Mg_2SiO_4 phase field suggests that phase equilibrium during hot-pressing is not totally attained despite the x-ray diffraction evidence that the bulk of the materials has reached equilibrium. The exact composition of the noncrystalline phase varies from one location to another in the microstructure and incorporates impurities including Ca, Al, and Cl. These impurities will unquestionably affect the high temperature properties of the intergranular phase.

17140 **(DOE/ER/02899—T2) Influence of grain boundaries on the electrical properties of polycrystalline-silicon films. Progress report, 1980-1981.** Ast, D.G. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). 1981. Contract AS02-76ER02899. 114p. NTIS, PC A06/MF A01.

Research in 1980/81 was carried out in three areas: (i) electron diffraction experiments on diffusion bonded (welded) boundaries; (ii) combined EBIC and high voltage transmission electron microscopy in order to investigate the correlation between structure and electrical properties and (iii) passivation of the electrical activity of crystal defects with hydrogen. The diffraction experiments did not furnish new information on the structure of grain boundaries in silicon, but were valuable as a check on the previous findings. In addition, they offered the possibility to separate double diffraction effects from boundary scattering. The combined EBIC and HVTEM experiments established (for the first time) unambiguously that coherent twin boundaries per se are not electrically active. The localized electrical activity observed in coherent twin boundaries is due to the presence of intrinsic dislocations, which are partial dislocations of the Schottky type. However, not all partial dislocations studied were electrically active, for reasons which are not completely understood. The combined EBIC and HVTEM investigations showed further (again for the first time) that many of the linear boundaries which were previously assumed to be coherent twin boundaries are second order twins, and that these twins are strongly electrically active. In passivation experiments, it is necessary to separate influence of the heat treatment from those of hydrogen. Passivation reduces the activity of some, but not of all defects. Passivation is particularly effective in reducing the electrical activity of deformation induced dislocations, which conceivably have a different core structure from grown-in dislocations.

17141 **Determination of laser damage thresholds by comparison with an absolute laser damage standard.** Milam, D.; Willis, J.B.; Rainer, F.; Wirtenson, G.R. (Lawrence Livermore National Laboratory, University of California, P. O. Box 5508 Livermore, California 94550). W-7405-ENG-48. *Applied Physics Letters ;* **38**: No. 6, 402-404(15 Mar 1981).

Absolute laser-damage thresholds can be rapidly measured by comparison with an absolute laser-damage standard. Multiple-layer TiO_2/SiO_2 antireflection films on BK-7 glass were found to be the best available damage standards for use at 1064 nm.

17142 **(LA-UR—81-1021) Absorption spectra of AgI at pressures to 136 kbar.** Liebenberg, D.H.; Hudson, J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810429—2). NTIS, PC A02/MF A01.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

Spectral absorption measurements in AgI are reported at pressures up to 136 kbar using a diamond anvil cell. In the NaCl phase between 5 and 70 kbar the absorption edge shift is found to be nearly linear with pressure. No indication of a sudden jump into a CsCl phase is found near 100 kbar and the possible influence of larger pressure gradients in earlier measurements is discussed.

17143 **(SAND—80-2192) Glass ceramics for sealing to high-thermal-expansion metals.** Wilder, J.A. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01.

Glass ceramics were studied, formulated in the Na_2O $CaO.P_2O_5$, $Na_2O.BaOP_2O_5$, $Na_2O.Al_2O_3.P_2O_5$, and $Li_2O.BaO.P_2O_5$ systems to establish their suitability for sealing to high thermal expansion metals, e.g. aluminum, copper, and 300 series stainless steels. Glass ceramics in $Na_2O.CaO.P_2O_5$ and $Na_2O.BaO.P_2O_5$ systems have coefficients of thermal expansion in the range 140 x 10^{-7} per °C $\leqq \alpha \leqq$ 225 x 10^{-7} per °C and fracture toughness values generally greater than those of phosphate glasses; they are suitable for fabricating seals to high thermal expansion metals. Crystal phases include $NaPo_3$, $(NaPO_3)_3$, $NaBa(PO_3)_3$, and $NaCa(PO_3)_3$. Glass ceramics formed in the $Na_2O.Al_2O_3.P_2O_5$ systems have coefficients of thermal expansion greater than 240 x 10^{-7} per °C, but they have extensive microcracking. Due to their low thermal expansion values ($\alpha \leqq$ 120 x 10^{-7} per °C), glass ceramics in the $Li_2O.BaO.P_2O_5$ system are unsuitable for sealing to high thermal expansion metals.

17144 **(SAND—81-0475C) Chemical vapor deposition of boron at low temperatures.** Pierson, H.O.; Mullendore, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 11p. (CONF-810425—4). NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Francisco, CA, USA (6 Apr 1981).

The formation of boron coatings obtained from the dissociation of diborane as a function of temperature, pressure and the effect of plasma activities is investigated. At one atm. pressure, pure boron was formed only at deposition temperatures above 500°C; below that temperature partial dissociation occurred and the deposited boron was combined with boron polymers. To remove these polymers (as they were formed), it was necessary to operate at low pressure (~ 50 m Torr); this allowed boron coatings to be deposited at temperatures as low as 350°C. By activating the diborane in a RF field, it was possible to deposit boron as low as 150°C. In all cases, the deposited boron was very dense, uniform and amorphous.

17145 Macroscopic theory of pulsed-laser annealing. I. Thermal transport and melting. Wood, R.F.; Giles, G.E. (Oak Ridge National Lab., TN). *Physical Review [Section] B: Condensed Matter ;* **23**: No. 6, 2923-2942(15 Mar 1981).

Pulses of radiation from ruby and Nd:YAG Q-switched lasers have been used recently to anneal the lattice damage caused by ion implantation of semiconductors. Other similar applications include the laser-induced diffusion of thin dopant films deposited on the surface of samples, recrystallization of doped amorphous films deposited on single-crystal substrates, and the removal of precipitates present after conventional high-temperature dopant diffusion. All of these processes can be understood in terms of models and calculations based on macroscopic diffusion equations for heat and mass transport, cast in a finite-difference form to allow for the temperature and spatial dependences of the thermal conductivity, absorption coefficient, reflectivity, and other quantities. Results of calculations on silicon with the models show that the near-surface region of a sample can melt and stay molten for times of the order of 100 nsec during which dopant diffusion in the liquid state and nonequilibrium segregation during ultrarapid recrystallization are sufficient to explain the major features of the experimental results. In this paper, a description of the model used in our heat-transport calculations is given. Results of the modeling are illustrated by a variety of calculations which should be of particular interest to experimentalists working with pulsed-laser annealing. These results include, e.g., the effects of pulse duration, shape, and energy density, the effects of assumptions made about the latent heat of amorphous silicon, the effects of substrate heating, the role played by the absorption coefficient in determining melt-front penetration, and the duration of surface melting.

17146 . Control of melt-front velocity during pulsed laser annealing. Wood, R.F.; Giles, G.E. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Applied Physics Letters ;* **38**: No. 6, 422-423(15 Mar 1981).

The high recrystallization velocities attained in the pulsed-laser annealing of ion-implanted semiconductors lead to remarkable nonequilibrium segregation effects. Detailed studies of these effects and the physical mechanisms which underlie them require control of the recrystallization velocity over a wide range. In this letter, the results of computer calculations are used to demonstrate three methods for controlling the regrowth velocity in Si and to indicate the range of velocities which may be expected by the methods.

17147 Influence of carrier diffusion on melt-front penetration during pulsed-laser annealing. Wood, R.F. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Applied Physics Letters ;* **38**: No. 5, 357-359(1 Mar 1981).

It is shown that although carrier diffusion may increase the effective depth for energy absorption by the lattice during pulsed-laser annealing of semiconductors, it is unlikely that this increase will significantly alter the conclusions of the melting model of laser annealing.

17148 Growth of extremely uniform layers by rotating substrate holder with molecular beam epitaxy for applications to electro-optic and microwave devices. Cho, A.Y.; Cheng, K.Y. (Bell Labs., Murray Hill, NJ). *Applied Physics Letters ;* **38**: No. 5, 360-362(1 Mar 1981).

Integrated optics and integrated microwave circuits require extremely uniform epitaxial layer thicknesses, composition profiles, and doping profiles. With a sample rotating mechanism, molecular beam epitaxy can for the first time prepare GaAs and Al/sub x/Ga/sub 1-x/As layers with thickness variation of less than 1% over a lateral dimension of 5 cm. The variation of AlAs mole fraction of the $Al_{0.3}Ga_{0.7}As$ over a 10-cm^2 area was less than 0.4%. The variation of the pinch-off voltage for a field effect transistor structure was less than 1.4% over a 10-cm^2 wafer. These results represent the most uniform epitaxial layers ever prepared with any crystal growth technology.

17149 Thermodynamics of the lanthanide trifluorides. IV. The heat capacities of gadolinium trifluoride GdF_3, lutetium trifluoride LuF_3, and yttrium trifluoride YF_3 from 5 to 350°K. Flotow, H.E.; O'Hare, P.A.G. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Journal of Chemical Physics, The ;* **74**: No. 5, 3046-3055(1 Mar 1981).

The heat capacities of three isostructural trifluorides GdF_3, LuF_3, and YF_3 were determined from 5 to 350°K by adiabatic calorimetry. Below 15°K GdF_3 contained an excess heat capacity contribution over the usual lattice heat capacity; LuF_3 and YF_3 showed no unusual heat capacities over the entire temperature range. Results in tabular form which list the heat capacity C°/sub p/, the entropy S^0, the enthalpy $[H^0(T)-H^0(0)]$, and the Planck function $-[G^0(T)-H^0(T)]/T$ are given for the three trifluorides. Also presented are recommended thermochemical functions at 298.15°K and tables of recommended high-temperature thermodynamic functions from 400°K to the melting temperatures. The excess entropy associated with GdF_3 is discussed and values of the lattice heat capacity of GdF_3 below 15°K are estimated.

17150 Transmission electron microscopy and Rutherford backscattering studies of single and double discrete buried damage layers in P^+ implanted Si on subsequent laser annealing. Sadana, D.K.; Strathman, M.; Washburn, J.; Booker, G.R. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics ;* **52**: No. 2, 744-747(Feb 1981).

This work is aimed at studying the regrowth behavior of single and double buried damage layers on subsequent laser annealing of P^+ implanted Si, implanted at 120 keV to doses of 5 x 10^{14}/cm^2 and 7.5 x 10^{15}/cm^2, respectively. A Q-switched ruby laser operating at a wavelength of 1094 nm was used for the annealing. 90° cross-sectional transmission electron microscopy (TEM) and MeV He^+ channeling spectroscopy were used to examine the damage structures and their depth distributions. At 0.9 J/cm^2, TEM results showed that the single buried damage layer regrew into two discrete damage layers. At 2.0 J/cm^2, TEM results showed that the first layer in the double buried damage layers type structures either completely anneal out, leaving a partially annealed second layer consisting of damage clusters or had dislocations in the first damage layer region that extended from the surface and were in direct contact with the deeper lying second layer of damage clusters. The MeV He^+ channeling spectra for the above samples were in agreement with the TEM results.

17151 Single-crystal elastic constants of MgF_2 in the temperature range 4.2—300 K. Kandil, H.M.; Greiner, J.D.; Ayers, A.C.; Smith, J.F. (Ames Laboratory, and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). WPAS-AS-01-02-01. *Journal of Applied Physics ;* **52**: No. 2, 759-763(Feb 1981).

The six independent elastic constants of single crystals of tetragonal MgF_2 have been measured over the temperature range 4.2—300 K. All six of the conventional constants show normal negative temperature dependences. The shear constants associated with normal modes of deformation tend to be weak, and one of these, (1)/(2) $(C_{11}-C_{12})$, also exhibits a weak positive temperature dependence as do all other fluorides with the rutile structure for which data are available. The data indicate a high degree of anisotropy in the atomic force interactions. A Debye temperature evaluated from the single-crystal elastic constants when combined with two empirical Einstein temperatures satisfactorily describes tabulated heat-capacity data to within 1%.

17152 Laser-induced dielectric breakdown in cryogenic liquids. Brueck, S.R.J.; Kildal, H. (Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts 02173). *Journal of Applied Physics ;* **52**: No. 2, 1004-1010(Feb 1981).

Spot size and pulse length dependences of CO_2 laser-induced breakdown in the cryogenic liquids N_2, O_2, CO, and Ar are reported. Parameters which affect the dielectric strengths are identified and the results are compared with previous dc measurements. Diagnostic measurements of photoconductivity, fluorescence and laser-induced pressure (acoustic), and density fluctuations to characterize the breakdown processes are reported.

17153 **Studies of the hydrogen passivation of silicon grain boundaries.** Seager, C.H.; Ginley, D.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics ;* **52**: No. 2, 1050-1055(Feb 1981).

A model is presented which predicts the current flow through and around grain boundaries which have been treated with atomic hydrogen to reduce their trap-state densities. Measurements on hydrogenated silicon grain boundaries are shown to be in agreement with this model and quantitative estimates of hydrogen penetration depth are made. The dependence of this depth on sample temperature, surface preparation, hydrogen pressure, and geometry are systematically investigated. Maximum penetration is achieved in high-pressure discharges for sample temperatures between 350 and 400 °C. The condition of the surface of the polycrystalline silicon is shown to be critically important for the in-diffusion process.

17154 **UV photoemission from ZrF_4.** Brandt, D.; Pong, W. (Department of Physics and Astronomy, University of Hawaii, Honolulu, Hawaii 96822). *Journal of Applied Physics ;* **52**: No. 2, 1130-1131(Feb 1981).

Photoemission measurements on ZrF_4 films were made in the photon energy range 10—27 eV. Spectral yield and photoelectron energy distributions were measured. The results indicate that the valence-band width is 5.1 +- 0.2 eV and the photoemission threshold is 13.4 +- 0.2 eV.

40 CHEMISTRY

17155 **Mechanism of the H + O_3 reaction.** Chen, M.M.L.; Wetmore, R.W.; Schaefer, H.F. III. (Lawrence Berkeley Lab., CA). *Journal of Chemical Physics, The ;* **74**: No. 5, 2938-2944(1 Mar 1981).

The H + O_3 reaction has played an important role in the evolution of modern chemical kinetics. Here certain aspects of the HO_3 potential energy hypersurface have been investigated using nonempirical molecular electronic structure theory. For the qualitative purposes of the present study, most wave functions were of the self-consistent-field (SCF) variety, constructed from a double zeta basis set of contracted Gaussian functions. Two low energy pathways were established for the reaction. The first involves a coplanar transition state with a nearly linear H-O-O arrangement. The second possible mechanism allows the hydrogen atom to descend perpendicularly upon the ozone molecule. The two mechanisms are evaluated in light of the current experimental understanding of the H + O_3 reaction.

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 17203, 17338, 17344, 17370, 17525

17156 **(BNL—29258) Tell el Yahudiyeh Ware: a re-evaluation.** Kaplan, M.F.; Harbottle, G.; Sayre, E.V. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 30p. NTIS, PC A03/MF A01.

The TY (Tell el Yahudiyeh ware) project has implications for understanding the cultural interactions. The Second Intermediate Period (1750-1550 B.C.), one during which centraized government in Egypt collapses and, it is generally assumed, so does her trade network. Foreigners - the Hyksos - are able to enter the country and rule at least part of it. Results of this study (which includes activation analysis), however, indicate the TY is primarily an Egyptian pottery which appeared before the Hyksos entered and may have continued in use after they left. It cannot, therefore, be tightly associated with the Hyksos nor can it be used to judge the extent of their influence. Its wide distribution shows that Egypt continued to trade goods outside her boundaries throughout this period. Finally, not only goods travelled between what were generally considered to have been hostile neighbors, but the trade appears to have included ideas and technology as well.

17157 **(LA-UR—81-898) Recent applications of ^{13}C NMR spectroscopy to biological systems.** Matwiyoff, N.A. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 26p. (CONF-810339—2). NTIS, PC A03/MF A01.

From 4. international conference on stable isotopes; Julich, F.R. Germany (23 Mar 1981).

Carbon-13 nuclear magnetic resonance (NMR) spectroscopy, in conjunction with carbon-13 labelling, is a powerful new analytical technique for the study of metabolic pathways and structural components in intact organelles, cells, and tissues. The technique can provide, rapidly and non-destructively, unique information about: the architecture and dynamics of structural components; the nature of the intracellular environment; and metabolic pathways and relative fluxes of individual carbon atoms. With the aid of results recently obtained by us and those reported by a number of other laboratories, the problems and potentialities of the technique will be reviewed with emphasis on: the viscosities of intracellular fluids; the structure and dynamics of the components of membranes; and the primary and secondary metabolic pathways of carbon in microorganisms, plants, and mammalian cells in culture.

17158 **(ORNL/TM—7608) Microcomputer-controlled remote pipetter: design and evaluation of a prototype system.** Goeringer, D.E.; Klatt, L.N. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

A prototype remote pipetter has been designed and evaluated. The principle of operation for the pipetter is the displacement of liquid via a calibrated, screw-driven plunger. Variably sized aliquots of 1 to 1000 μl can be delivered. A stepping motor is used to move the plunger, and its position is verified with a linear variable differential transformer. The unit is controlled by a microcomputer. Besides the required operation sequences and error checking, a self calibration check has been designed into the software. Accuracy and precision of plunger movements corresponding to delivery of aliquots ranging from 100 to 500 μl are 0.3 μl and 0.4 μl respectively. Nonlinearity over the full range of plunger travel is 0.02%.

17159 **Trace detection of N_2 by KrF-laser-excited spontaneous Raman spectroscopy.** Hargis, P.J. Jr. (Sandia Labs., Albuquerque, NM). *Applied Optics ;* **20**: No. 1, 149-152(1 Jan 1981).

A 100-mJ/pulse 10-Hz KrF laser has been used for pulsed-uv-excited vibrational Raman spectroscopy. Gated photon counting techniques were used to detect Raman signals that were linear for N_2 partial pressures between 10^{-4} and 2 x 10^{-3} torr. Single-shot Raman signals were linear for N_2 partial pressures between 0.5 and 600 torr. No interferences from laser-induced nonlinear effects were observed.

17160 **Electro-optical detector for spark source mass spectrometry. Pt. 2. Quantitative measurements.** Donohue, D.L.; Carter, J.A. (Oak Ridge National Lab., TN (USA). Analytical Chemistry Div.); Mamantov, G. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). *Journal of Mass Spectrometry and Ion Physics ;* **35**: No. 3/4, 243-257(Sep 1980).

A channel electron multiplier array detector (CEMA) for spark source mass spectrometry (SSMS) has been evaluated for possible quantitative analytical applications. CEMA with SSMS in the quantitative mode offers real-time data acquisition and the ability to monitor several ions simultaneously, which permits rapid optimization of instrumental parameters. Compared to a discrete dynode electron multiplier, CEMA displays similar sensitivities and resolutions. Measurement precisions are intermediate between rapid logarithmic scan and the slower peak switching methods. For isotope dilution analysis, CEMA shows a precision of about +- 5% RSD up to a 5:1 spike/sample ratio compared to about +- 10% at a 3:1 ratio for photographic detectors. Suggestions are offered for improving the CEMA detector.

17161 **Direct determination of niobium in uranium-niobium alloys.** Long, J.L. (Rockwell International, Golden, CO). *Advances in X-Ray Analysis ;* **23**: 177-183(1980).

An x-ray fluorescence procedure was devised for analyzing niobium in uranium-niobium alloys, which completely eliminates wet chemical preparation of samples. This was accomplished by pressing turnings into compacts and determining niobium and uranium intensities on the surface of the compact. Standards were prepared by relating x-ray intensity data to precisely selected samples

analyzed by a wet chemical procedure. The statistical variability in niobium results has been reduced to the level where meaningful correlations are obtained when an arc melted ingot is sectioned and analyzed. In addition to the above benefits, a time savings by a factor of 3 or greater has been realized.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 16550, 16589, 17177, 17178

17162 Axial ligand effects on iron and manganese porphyrins: extended Hueckel calculations of Cyt P450 analogs and of O_2 binding to iron and manganese. Hanson, L.K. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *International Journal of Quantum Chemistry, Quantum Biology Symposium ;* **6**: 73-87(1979).

Certain axial ligand-metal interactions can perturb the electronic structure of metallorporphrins in ways that significantly alter their optical and magnetic spectra. Two classes of such interactions, the origin of the anomalous optical spectra of the hydroxylating enzyme cytochrome P450 and the nature of molecular oxygen binding to Fe(II) and Mn(II) porphyrins, have been examined by charge iterative extended Hueckel calculations. (1) Calculations performed on various low-spin ferrous and ferric porphin RS^- (mercaptide) and RSH (mercaptan) complexes support the hypothesis that the anomalous spectra of cyt P450 complexes are due to mercaptide sulfur p $\rightarrow$ porphin π^* charge transfer transitions which mix with the porphin $\pi \rightarrow \pi^*$ transitions. (2) Oxy Fe and Mn porphins were calculated with O_2 bound in the Pauling (end on, bent) and Griffith (edge on, parallel to the porphin ring) modes. On the basis of optical spectra, the Fe calculations cannot distinguish between the two possible modes of O_2 binding. In the Mn case, however, all the experimental optical and magnetic data can be explained in terms of the Griffith model but not the Pauling model. The anomalous optical spectra of oxy Mn porphrns are ascribed to porphin $\pi \rightarrow$ d/sub π/ + $O_2\pi$/sub g/ charge transfer transitions which mix with the porphin $\pi \rightarrow \pi^*$ transitions.

17163 (ANL—81-7) Effects of curvature on asymmetric steady states in catalyst particles. Lucier, B.J. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01.

The effects of curvature on steady states of chemical catalytic reactions are investigated by studying the cases of the catalytic particle being a spherical or cylindrical shell. Existence and stability of solutions are studied. It is shown that the solutions converge to the solutions for the catalytic slab when the curvature goes to 0 in each case.

17164 (DOE/ER/10439—2) Chemical reaction and turbulence. Progress report, June 1, 1980-May 31, 1981. Chevray, R. (State Univ. of New York, Stony Brook (USA)). Jan 1981. Contract AC02-79ER10439. 23p. NTIS, PC A02/MF A01.

The experimental techniques to be used to carry out the measurements have been developed both for the velocity and concentration fluctuation measurements. The calculations of the reacting mixing layer indicate that the region of interest, where finite rates play a role, is 0.3 < x/ sup */ < 10.0. With U_1 = 5 m/s, and an ozone concentration of 0.1% this range is 0.4 cm < x < 12.5 cm. For the conditions stated, at x/sup */ = 5 the mixing layer thickness is just 4 mm and the ratio of laminar to turbulent viscosity is 0.1. It should be noted that the modelling assumes a high Reynolds number throughout and is likely to be inaccurate in the developing region. The profiles of < c(eta, x/sup */) > shown on figures 5 and 6 also indicate that this quantity is not very sensitive to the modelling of the finite-rate reaction. The difference of 20% is most likely less than the combined uncertainty in the measurements and the turbulence mode. On the other hand, the profile of $< c'^2 >$ and R/sub cf/ shows some interesting trends which are likely to depend on the details of the modelling. These quantities, then, can be expected to be the more useful results of the experiment.

17165 (DOE/ER/10612—2) Feasibility of closed Fe(II)/Fe(III) system for product-reflux in Nitrox process. Adachi, M.; Ishida, T. (State Univ. of New York, Stony Brook (USA)). 10 Mar 1981. Contract AC02-80ER10612. 28p. NTIS, PC A03/MF A01.

A concept of closed reflux system for stable isotope fractionation by chemical exchange method has been introduced. In a closed system a chemical agent used to convert one chemical species of an isotopic exchange reaction into the other at the product end is regenerated on site by means of an electrochemical or thermal process. It offers a convenience of eliminating the needs for transporting chemicals to and from the site and an advantage of allowing leniency in the degree of completeness of the reflux reaction. Feasibility of use of Fe(II) salt solutions in a closed reflux system for the Nitrox process for ^{15}N fractionation has been studied. Two of such systems, $FeSO_4$ in H_2SO_4 and $Fe(ClO_4)_2$ in $HClO_4$, are adopted for packed column operation. For both systems, the rate of reduction of nitric acid increases with increasing acid concentration, the solubility of the salts decreases with the increasing acid concentration, and the reflux reaction can be made to go to completion. Evaluation of such a closed reflux system will have to include that of performance of regenerative process.

17166 (IS-T—911) Crystal-structure determinations of Lu_3S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes. Powell, D.R. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 113p. NTIS, PC A06/MF A01.

Thesis.

The crystal structures of five selected inorganic compounds have been determined from single crystal x-ray measurements. Each of these materials was found to have interesting and novel structural features. Metallic Lu_3S_4 was found to crystallize in the orthorhombic space group F/sub ddd/ with a = 10.747(3), b = 22.813(6), and c = 7.602(2)A. The 3-R form of $Nb_{1.06}S_2$ crystallizes in the space group R_3/sub m/ with hexagonal lattice parameters a = 3.3285(4) and c = 17.910(4)A. The compound bis (δ-camphorquinone dioximato) nickel(II), (δ-HCQD)$_2$, crystallizes in the orthorhombic space group $P(2_1)(2_1)(2_1)$ with a = 13.175(1), b = 13.652(2), and c = 12.031(3)A. The hexanuclear cluster complex [Ni(δ-HCQD)$_2$. Ag]$_3$. 2-1/2 $CHCL_3$ crystallizes in the orthorhombic space group $P(2_1)(2_1)(2_1)$ with a = 15.990(5), b = 38.44(1), and c = 13.437(5)A. The compound cis-dichlorobis(methyldiphenylphosphinite)-palladium(II) crystallizes in the monoclinic space group $P(2_1)$/sub n/ with a = 12.539(6), b = 13.741(4), c = 15.147(4)A, and β = 94.6(5)^0. Detailed descriptions of each compound are given.

17167 (IS-Trans—111) Wet chemical method for the production of synthetic raw materials and homogeneous powders for physical-chemical studies. Teynen, P.; Bastius, H.; Faizullah, M.; Kamptz, H.V. Translation of *Berichte der Deutschen Keramischen Gesellschaft E. V. ;* **54**: No. 3, 63-68(1977). 14p. NTIS, PC A02/MF A01.

The preparation of homogeneous reactive powders by wet chemical processes is reviewed. The various methods are described in brief and a new method called hot petroleum drying is presented. There are two main fields of interest for the preparation of powders. Firstly for physico-chemical investigations (such as sintering, heterogeneous equilibria studies, physical properties as a function of chemical composition, impurity level and microstructure) we need series of samples with precisely known composition, but the amount of powder here required is small. For such types of work freeze-drying, emulsion-drying sol gel process and the newly proposed hot-petroleum-drying are the most suitable techniques. The preparation of Ackermanite and Gehlenite compositions by freeze drying and hot petroleum drying is discussed. Secondly, the production of synthetic raw materials is described. The spray drying process is especially suitable for this purpose. It is shown that bentonite mixed with molten aluminium sulphate can be easily transformed into a dry powder which, upon decomposition, gives mullite. Other compositions, e.g., cordierite can be prepared in a similar way. The drying process and the thermal decomposition can be executed in one operation by pouring the slurry on a hot plate heated to a temperature of 950 to 1000 C.

17168 **(MLM—2815(OP)) Separation of the stable isotopes of Cl, S and Ca.** Rutherford, W.M. (Mound Facility, Miamisburg, OH (USA)). 1981. Contract AC04-76DP00053. 15p. (CONF-810339—1). NTIS, PC A02/MF A01.

From 4. international conference on stable isotopes; Julich, F.R. Germany (23 Mar 1981).

The stable isotopes of sulfur and chlorine are being separated on a practical scale by liquid phase thermal diffusion. The present capacity of a small separation system occupying $3m^2$ of laboratory floor space is 0.5 kg of chlorine isotopes per year at enrichments of 95% ^{37}Cl and 99.5% ^{35}Cl. A similar system for the separation of sulfur isotopes has a capacity of 0.3 kg/yr of ^{34}S enriched to 93%. The feasibility of separating Ca isotopes by thermal diffusion of an aqueous solution was demonstrated. It appears to be possible to enrich ^{48}Ca up to 10% in a thermal diffusion system comparable in size to those used for Cl and S isotopes.

17169 **(ORNL—5747) WMIN: a computer program to model molecules and crystals in terms of potential energy functions.** Busing, W.R. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 174p. NTIS, PC A08/MF A01.

This report describes the computer program WMIN which can be used to manipulate static and dynamic models of crystals or isolated molecules and to calculate their energies from interatomic potential functions. It is applicable to a wide variety of substances ranging from ionic crystals to large organic molecules. The report includes a description of the program, instructions for data input, a program listing, and the output from test problems.

17170 **Study of the ion—molecule half reactions $O^+Z(a\ ^4Pi/sub\ u/, v)xxx(O_2)/sub\ m/\rightarrow O^+/sub\ 2m/+1+O$, m=1, 2, or 3, using the molecular beam photoionization method.** Linn, S.H.; Ono, Y.; Ng, C.Y. (Ames Laboratory, U. S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics, The ;* **74**: No. 6, 3348-3352(15 Mar 1981).

The photoionization efficiency (PIE) curve for $(O_2)^+{}_2$ has been obtained in the region 650—1 080 A using the molecular beam photoionization method. The ionization energy (IE) for $(O_2)_2$ is determined to be 11.66 +- 0.03 eV. From the measured IE for $(O_2)^+{}_2$, the known IE for O_2, and the estimated dissociation energy (0.01 eV) of $(O_2)_2$, the binding energy for $(O_2)^+{}_2$ is deduced to be 0.42 +- 0.03 eV. Comparisons of the PIE spectra for $O^+{}_3$ and $(O_2)^+/sub\ m/$, where m=2, 3, and 4 indicate that the excited dimer complexes $O(_2(n,v)x(O_2)/sub\ m/$ (m=1, 2, and 3) formed in this wavelength region are almost completely dissociative, and the cluster ions are predominately formed by the direct photoionization processes $(O_2)/sub\ m/=2$, 3, or $4+h\nu\rightarrow(O_2)^+/sub\ m/=2$, 3, or 4+e. The PIE curves for $O^+{}_3$, $O^+{}_5$, and $O^+{}_7$ are measured in the region 650—780 A. The appearance energy 16.66 +- 0.03 eV (744 +- 1.5 A) for $O^+{}_3$ is found to be consistent with a zero activation energy for the ion-molecule reaction $O^+{}_2(X\ ^2Pi/sub\ g/)+O_2\rightarrow O^+{}_3+O$. The appearance energy for $O^+{}_5$ is determined to be 16.41 +- 0.06 eV (755.5 +- 3 A). This value has allowed the determination of a binding energy of 0.26 eV for $O^+{}_3xO_2$. The nearly structureless PIE spectra observed for $O^+{}_3$, $O^+{}_5$, and $O^+{}_7$ also suggests that these ions originate mainly from $(O_2)^+{}_2$, $(O_2)^+{}_3$, and $(O_2)^+{}_4$ which are formed by direct ionization processes. Using the relative Franck—Condon factors for the O_2 $a\ ^4Pi/sub\ u/\leftarrow X\ ^3\Sigma^-/sub\ g/$ transitions, the relative reaction probabilities for the ion—molecule half reactions $O^+{}_2(a\ ^2Pi/sub\ u/, v)x(O_2)/sub\ m/\rightarrow O^+/sub\ 2m/+1+O$(m=1, 2, and 3): (1): as a function of the vibrational quantum number v have been determined.

17171 **Chemical kinetic functional sensitivity analysis: Elementary sensitivities.** Demiralp, M.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics, The ;* **74**: No. 6, 3362-3375(15 Mar 1981).

Sensitivity analysis is considered for kinetics problems defined in the space—time domain. This extends an earlier temporal Green's function method to handle calculations of elementary functional sensitivities $\delta u/sub\ i//\delta\alpha/sub\ j/$ where u/sub i/ is the ith species concentration and $\alpha/sub\ j/$ is the jth system parameter. The system parameters include rate constants, diffusion coefficients, initial conditions, boundary conditions, or any other well-defined variables in the kinetic equations. These parameters are generally considered to be functions of position and/or time. Derivation of the governing equations for the sensitivities and the Green's funciton are presented. The physical interpretation of the Green's function and sensitivities is given along with a discussion of the relation of this work to earlier research.

17172 **Determination of metal crystallite size and morphology in supported nickel catalysts.** Mustard, D.G.; Bartholomew, C.H. (Brigham Young Univ., Provo, UT). Contract EF-77-S-01-2729. *Journal of Catalysis ;* **67**: No. 1, 186-206(Jan 1981).

The application of H_2 chemisorption, x-ray diffraction (XRD) line broadening, and transmission electron microscopy (TEM) to the determination of metal crystallite size and size distribution in Ni/SiO_2, Ni/Al_2O_3, and Ni/TiO_2 catalysts having wide ranges of nickel loadings and dispersions was investigated. Average crystallite diameters estimated from H_2 chemisorption and TEM were found to be in very good agreement over wide ranges of metal dispersion and loading in the Ni/SiO_2 system and in good agreement for a 15% Ni/Al_2O_3; poor agreement was evident in the Ni/TiO_2 system, the results suggesting that H_2 adsorption was suppressed. In the few samples where it was possible to obtain information from XRD, the estimates of crystallite diameter were generally in good or fair agreement with those from H_2 chemisorption or TEM. The specific limitations of these three techniques in determination of nickel crystallite size and their application to the study of sintering and metal support interactions in supported nickel catalysts are presented and discussed.

17173 **Chemisorption of carbon monoxide on reduced molybdena.** Ramakrishnan, N.R.; Weller, S.W. (State Univ. of New York, Buffalo). Contract E(49-18)-2013. *Journal of Catalysis ;* **67**: No. 1, 237-239(Jan 1981).

Surface coverage of reduced molybdena by chemisorbed CO is substantially lower than the surface coverage by chemisorbed O_2. The surface coverage by chemisorbed CO decreases as the temperature of chemisorption is increased from -195 to 0°C. Chemisorption of O_2 at low temperatures is to be preferred to that of CO as a possible means of measuring the dispersion of reduced molybdena on an alumina support.

17174 **Polarized x-ray absorption and double refraction in vanadyl bisacetylacetonate.** Templeton, D.H.; Templeton, L.K. (Univ. of California, Berkley). Contract W-7405-ENG-48. *Acta Crystallographica ;* **A36**: 237-241(1980).

X-ray dichroism is observed in crystalline vanadyl bisacetylacetonate, $VO^{2+}.2(C_5H_7O_2)^-$, near the vanadium K edge in absorption experiments with linearly polarized synchrotron radiation. The Kossel structure is polarized as a result of the symmetries of molecular orbitals in this strongly anisotropic molecule. The extended x-ray absorption fine structure is polarized because of the difference in distance to the axial and equatorial oxygen neighbors. In this wavelength region, the anomalous-scattering terms and the index of refraction vary with the direction of polarization. Some of the consequences and possible applications of these properties are discussed.

17175 **Existence of solitary traveling wave solutions of a model of the Belousov-Zhabotinskii reaction.** Field, R.J.; Troy, W.C. (Univ. of Montana, Missoula). *SIAM (Society for Industrial and Applied Mathematics) Journal on Applied Mathematics (Formerly Journal of the Society for Industrial and Applied Mathematics) ;* **37**: No. 3, 561-587(Dec 1979).

We investigate a system of partial differential equations which model the reaction-diffusion dynamics of the Belousov-Zhabotinskii chemical reaction. Our system is developed from the Oregonator model of Field and Noyes. Over a physically reasonable range of parameters for which the system exhibits no temporal oscillations, we show that the equations have a solitary traveling wave solution. These waves appear to correspond to the trigger waves observed experimentally in the reaction. In addition we show that if the autocatalytic reaction is sufficiently slow, then as expected from the chemistry, the model has no solitary traveling wave solutions. We numerically compute the wave speed and it is

shown to be close to the observed speed of the trigger waves. Also, the dependence of the wave speed on the various measurable physical parameters in the model is computed and shown to be in excellent agreement with that observed.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 16397, 17133, 17162, 17166, 17174, 17358, 17618

17176 INDO study of the anion radicals of acetic acid and acetamide. Nonplanarity and barriers to methyl group rotation. Suryanarayana, D.; Sevilla, M.D. (Oakland Univ., Rochester, MI). *Journal of Physical Chemistry, The ;* **84**: No. 23, 3045-3049(13 Nov 1980).

The anion radicals of acetic acid and acetatamide were investigated by using the INDO method. Energy calculations suggest that the radical $RC(X_1)(X_2)$ (with R = CH_3; X_1 = O^-, OH; X_2 = OH and NH_2 is pyramidal rather than planar with a nonplanar angle phi = 27° in the case of R-C(O^-)(OH). A comparison of the calculated and experimental β-proton and ^{13}C hyperfine splittings (hfs) suggests a slightly different value for phi (=35°). This latter value is in reasonable agreement with the value of 40° calculated previously from experiment. INDO calculations for the remaining radicals give similar values for phi. For nonplanar radical structures, it was found that the angular dependence of the INDO-calulated β-proton hfs did not obey a simple cosine square rule. Instead the calculated splittings have been fit by using the relation α/sub β/sup H/ = B/sub 1rho//sup π/ cos θ + B/sub 2rho//sup π/ θ with B/sub 1rho//sup π/ = 8.8 and B/sub 2rho//sup π/ = 28.0 G for the acetic radical. The threefold barrier height (V_3) as obtained from the INDO calculations was found to increase monotonically with phi. This suggests that the relatively high activation energies (>2.5 kcal/mol) reported for acetic acid and acetamide anions in our previous work are therefore a consequence of pyramidal geometry at α carbon. In light of these results, our previously reported threefold potential barrier heights for CH_3 rotation in acetic acid and acetamide radicals, which were analyzed by using a simple cosine square relation, have been reevaluated. The present analysis of our previous experimental data, including nonplanarity, gives a better fit yielding activation energy parameters as 2.4 to 2.6 kcal/mol for these radicals. These values are slightly lower than those values previously reported (2.7 to 3.1 kcal/mol), where the effect of nonplanarity on the β-proton splittings was not considered.

17177 (DOE/ER/10605—4) Fourth symposium on macrocyclic compounds. Christensen, J.J.; Izatt, R.M. (Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.). 1980. Contract AC02-80ER10605. 41p. (CONF-800896—(Absts.)). NTIS, PC A03/MF A01.

From 4. symposium on macrocyclic compounds; Provo, UT, USA (11 Aug 1980).

Both theoretical and experimental aspects of the properties and behavior of synthetic and naturally occurring macrocyclic compounds are covered in this symposium. This document contains abstracts of the papers. (DLC)

17178 (DOE/ER/70218—T2) Multiheteromacrocycles that complex metal ions. Fifth progress report, 1 May 1978-30 April 1979. Cram, D.J. (California Univ., Los Angeles (USA). Dept. of Chemistry). 15 Jan 1979. Contract AT03-76ER70218. 25p. NTIS, PC A02/MF A01.

The overall objective of this research is to design, synthesize and evaluate cyclic and polycyclic host organic compounds for their abilities to complex and lipophilize guest metal ions, their complexes and clusters. Host organic compounds consist of strategically placed solvating, coordinating and ion-pairing sites tied together by covalent bonds through hydrocarbon units around cavities shaped to be occupied by guest metal ions, or metal ions plus their ligands. Specificity in complexation is sought by matching the following properties of host and guest: cavity and metal ion sizes; geometric arrangements of binding sites; numbers of binding sites; characters of binding sites; and valences. The specific compounds synthesized and their complexing and lipophilizing properties are reported.

17179 High pressure study of viscosity effects on the luminescence of tetracyanobenzene EDA complexes. Thomas, M.M.; Drickamer, H.G. (School of Chemical Sciences and Materials Research Laboratory, University of Illinois at Urbana—Champaign, Urbana, Illinois 61801). *Journal of Chemical Physics, The ;* **74**: No. 6, 3198-3204(15 Mar 1981).

High pressure fluorescence studies fron 0—10 kbar have been performed on electron donor—acceptor (EDA) complexes of s-tetracyanobenzene (TCNB) with a series of aromatic hydrocarbons. Four solvents were used, 2,2,4,4,6,8,8 heptamethylnonane (HMN), methylcyclohexane (MCH), 2,6,10,14 tetramethylpentadecane (TMPD), and a mixture of MCH and HMN. A viscosity range from 0.006 to 10 000 poise was covered at constant temperature. As pressure (viscosity) increased the fluorescence spectrum shifted from one dominated by emission from the equilibrium (EQ) excited singlet state to one dominated by Franck—Condon (FC) singlet emission. Lifetime measurements for the complexes of o-xylene and p-xylene with TCNB as well as one mesitylene complex yielded the two radiative rates (k/sub EQ/ and k/sub FC/) as well as the rate of internal conversion from FC to the EQ excited state to (k/sub IC/). The results are discussed in terms of the rate of relaxation of the solvent compared with the rate k/sub FC/. It was found that k/sub IC/ correlated very well with the solvent viscosity.

17180 Comment on "IR lines broadened by chemical exchange". Weston, R.E. Jr. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics, The ;* **74**: No. 6, 3634-3635(15 Mar 1981).

In their recent publication[1] entitled "IR lines broadened by chemical exchange," the authors claim to be the first to observe line broadening in IR spectra due to chemical exchange. Their claim is disputed, it is argued that this phenomenon is widely reported in literature. (AIP)

17181 Evidence for H_2/D_2 isotope effects on Fischer-Tropsch synthesis over supported ruthenium catalysts. Kellner, C.S.; Bell, A.T. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Journal of Catalysis ;* **67**: No. 1, 175-185(Jan 1981).

The effects of using D_2 rather than H_2 during Fischer-Tropsch synthesis were investigated using alumina- and silica-supported Ru catalysts. For the alumina-supported catalysts, the rate of CD_4 formation was 1.4 to 1.6 times faster than the formation of CH_4. A noticeable isotope effect was also observed for higher molecular weight products. The magnitude of the isotope effects observed using the silica-supported catalyst was much smaller than that found using the alumina-supported catalysts. The formation of olefins relative to paraffins was found to be higher when H_2 rather than D_2 was used, independent of the catalyst support. The observed isotope effects are explained in terms of a mechanism for CO hydrogenation and are shown to arise from a complex combination of the kinetic and equilibrium isotope effects associated with elementary processes occurring on the catalyst surface.

17182 Alumina-catalyzed isotope exchange in CO/sup 1 2/. Moody, D.C.; Goldblatt, M.; McInteer, B.B.; Mills, T.R. (Los Alamos Scientific Lab., NM). *Journal of Catalysis ;* **67**: No. 1, 240-243(Jan 1981).

Catalytic isotope exchange in carbon monoxide has been found to occur over γ-alumina, 0.5% ruthenium/alumina, and molecular sieves. The exchange occurs readily at 400 to 500°C with little or no carbon dioxide formation.

17183 Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C. Franz, J.A.; Camaioni, D.M. (Pacific Northwest Lab., Richland, WA). Contract AC06-76RL0-1830. *Journal of Organic Chemistry, The ;* **45**: No. 26, 5247-5255(19 Dec 1980).

The 1,2 aryl migration and fragmentation reactions of 1-indanylmethyl (1), 2-tetralyl (2), 2-indanylmethyl (3), 1-tetralyl (4), 2-methyl-1-indanyl (5), and 1-methyl-2-indanyl (6) radicals were studied by flash vacuum pyrolysis of the tert-butyl perester precursors

at 327 to 627°C and 10^{-2} torr. Radicals 1 and 2 are interconverted via a 1,2 aryl migration which is readily reversible at all temperatures. This equilibrium is depleted by β scission of 1 and recyclization to 4 and by β scission of 2 followed by recyclization to 2 or to 3 in modest yields. The reverse neophyl-like rearrangement of 2 to 1 occurs with a lower activation barrier than β scission of 1 to form a 2-(o-vinylphenyl)ethyl radical. Enthalpies, entropies, and free energies of reaction were calculated for the above reactions from group additivity parameters, and activation energies were estimated from values reported for simple alkyl radicals. It is shown that the β scission of 4 and recyclization to 1 is important only at very high temperatures (> 500°C) as a mechanism for the isomerization of tetralin and related hydroaromatic structures to alkylindans and that the reverse neophyl-like rearrangement of 2 to 1 is the favored pathway for isomerizations observed during dissolution of coal in hydroaromatic media at elevated temperatures.

17184 **Improved crystal and molecular structure of guanidinium hydrogen oxalate monhydrate, $C(NH_2)_3HC_2O_4.H_2O$.** Andrews, L.C. (Brookhaven National Lab., Upton, NY); Deroski, B.R.; Ricci, J.S. *Journal of Crystal and Molecular Structure ;* **9**: No. 3, 163-171(1979).

The title compound crystallizes in space group P2/sub 1/c/ with a = 6.6922(25), b = 10.5468(8), c = 10.2125(19)A, β = 103.74(2)°, and Z = 4. The intensities were measured on an automated X-ray diffractometer, and the structure was refined to a final R_1 of 3.3% for 1106 reflections. The hydrogen bonding scheme is reported by Adams (1978) with one additional bond found.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 16663

17185 **(DOE/ER/02960—T1) Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981.** Devereux, O.F. (Connecticut Univ., Storrs (USA). Dept. of Metallurgy). Feb 1981. Contract AS02-76ER02960. 57p. NTIS, PC A04/MF A01.

The following tasks are reported on: electrode polarization studies in molten sodium carbonate, liquid line corrosion, and gas/metal reactions in mixed oxidants. Two previously unpublished papers are included as appendices: Reactions at the CO, CO_2/Ni electrode in Molten Sodium Carbonate; and Reactions at the Corroding Nickel Electrode in Molten Sodium Carbonate under CO, CO_2 Atmospheres. (DLC)

4005 Photochemistry

REFER ALSO TO CITATION(S) 16640, 17189, 17468

17186 **(DOE/ER/10392—4) Electron transfer in systems of well-defined geometry.** Overfield, R.E.; Kaufmann, K.J.; Wasielewski, M.R. (Illinois Univ., Urbana (USA). Dept. of Chemistry; Argonne National Lab., IL (USA)). 1980. Contract AC02-79ER10392. 5p. (CONF-800827—5). NTIS, PC A02/MF A01.

From 3. international conference on photochemical conversion and storage of solar energy; Golden, CO, USA (3 Aug 1980).

Two mesopyropheophorbide macrocycles can be joined via two covalent linkages to produce a cyclophane. It is possible to insert one or two Mg atoms into the cyclophane. The Qy transitions of the macrocycles are nearly orthogonal. The visible absorption spectrum of the monometal cyclophane is nearly a superposition of the spectra of the monomers. Emission from the monometal cyclophane arises primarily from the red most absorbing chromophore. The excited state difference spectrum shows that both macrocycles are excited. Fluorescence lifetimes of the monometal cyclophane decrease with increasing dielectric strength. Changes in the fluorescence and the triplet yield parallel the shortening of the singlet lifetime. Thus the radiative rate is solvent independent. This is in contrast to what one would expect if the emitting state had charge transfer character. Since the fluorescence lifetime is dependent on dielectric, the nonradiative relaxation from the singlet state is due to formation of a radical pair. The decay rate of the postulated radical pair was monitored by observing the kinetics of ground state repopulation. For the geometry of this cyclophane, electron transfer proceeds relatively slowly ($k = 3 \times 10^9$ sec^{-1}) in the forward direction. Modeling calculations indicate that the rate of annihilation of the radical pair may decrease as the solvent dielectric decreases.

17187 **(DOE/ER/10660—1) Multiphoton dissociation spectroscopy and photochemistry. Progress report, July 15, 1980-March 15, 1981.** Johnson, P.M. (State Univ. of New York, Stony Brook (USA)). 1981. Contract AC02-80ER10660. 7p. NTIS, PC A02/MF A01.

The apparatus necessary for the proposed experiments on the multiphoton photochemistry of molecules and the detection of radical species are being constructed. This includes the development of a time-of-flight mass spectrometer which operates in conjunction with a supersonic beam, and the construction of a supersonic beam apparatus suitable for use with metastable species and the detection of photofragments. This construction is near completion and we have been able to measure mass spectra with good resolution and sensitivity. We have also been developing our capacity for doing multiple laser experiments, which are particularly necessary in this work.

17188 **Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO.** Periasamy, N. (Tata Inst. of Fundamental Research, Bombay, India); Linschitz, H. *Chemical Physics Letters ;* **64**: No. 2, 281-285(1 Jul 1979).

Weak magnetic fields are found to increase the bulk ion-radical yield from a triplet radical pair, in temperature-viscosity region where cage recombination occurs. The results are consistent with Noyes' theory of geminate reactions and a hyperfine coupling mechanism for spin inversion leading to quenching.

4006 Radiation Chemistry

17189 **(DOE/ER/00038—2210) Radiation Laboratory, University of Notre Dame. Quarterly report, October 1, 1980-December 31, 1980.** (Notre Dame Univ., IN (USA). Radiation Lab.). 20 Jan 1981. Contract AC02-76ER00038. 40p. (NDRL—2210). NTIS, PC A03/MF A01.

Short summaries of thirty-seven investigations in progress in radiation chemistry and photochemistry are presented. Abstracts of twenty-three reports published are also presented. Some of the research in progress are: hyperfine coupling constants in methyl radical; theoretical calculations on 4-membered heterocyclic ring systems; absorption spectra of solvated electrons in THF; electron thermalization in liquid argon; electron capture in rare gases in competition with thermalization; electron spin densities for $LiOH_2$ in argon matrices; CO desorption and adsorption on Pt(III); radical reactions in combustion chemistry; laser photolysis of aqueous systems; laser flash photolysis study of hydrogen bending equilibria involving phenols; charge transfer interaction in the lowest singlet excited state of all-trans twenty-two carbon homologue of retinal; photoinduced redox transformations in macrocyclic complexes; photochemical properties of molybdenum complexes of dithiocarbamato ligands; scavenging reactions in the radiolysis of cyclopentane; determination of the products of oxidation of aniline by Ag(II); hydroxyl radical reactions with Ni(II) macrocyclic complexes.

17190 **Interfacial electron transfer involving radical ions of carotene and diphenylhexatriene in micelles and vesicles.** Almgren, M.; Thomas, J.K. (Univ. of Notre Dame, IN). *Photochemistry and Photobiology ;* **31**: 329-335(1980).

The radical cations and anions of diphenylhexatriene have been produced and characterized in homogenous and micellar solutions by pulse radiolysis and laser flash photolysis techniques. Both types of radical ions were formed in cyclohexane on pulse radiolysis. The radical cation was formed in dichloroethane on pulse radiolysis, and by two photon photoionization in ethanol, dichloroethane, and various micelles. Both radical ions have intense ($\epsilon \geq 10^5$ M^{-1} cm^{-1}) absorption peaks at 600 to 650 nm. The cation peak occurs at slightly shorter wavelengths than that of the anion. In mi-

celles and vesicles the radical anion of carotene was formed by electron transfer from e/sub aq/$^-$ on pulse radiolysis. The radical cation was formed on pulse radiolysis of micellar solutions containing Br_2^- as counterion, presumably by electron transfer to Br_2^-. The spectra agree with those of the radical cation and anion of carotene that have previously been obtained in homogenous solutions. Electron transfer in micelles and vesicles from the radical anion of biphenyl to carotene and diphenylhexatriene, and from the radical anions of these to inorganic acceptors has been studied.

17191 **Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study.** Almgren, M.; Grieser, F.; Thomas, J.K. (Univ. of Notre Dame, IN). *Journal of the Chemical Society (London), Faraday Transactions, I ;* **75**: 1674-1687(1979).

Pulse radiolysis has been used to measure the rate at which sodium lauryl sulphate monomer surfactant units enter into and exit from surfactant micelles. The free radical of the monomer is generated via OH attack following radiolysis and its reaction with ferricyanide noted. The rate constant for this reaction is 3.2 x 10^8 dm^3 mol^{-1} s^{-1} at 25°C. In micellar solution two distinct rate processes are observed corresponding to the previous reaction, which is in competition with monomer radical entering the micelle. Radicals in the micelle react slowly with ferricyanide due to like charge repulsion of the micelle and this ion. The rate constants for exit, k^-, and entry, k^+, are $k^- = 1.8 \times 10^5\ s^{-1}$ and $k^+ = 1.5 \times 10^9\ dm^3\ mol^{-1}\ s^{-1}$. These data agree well with those obtained by other methods. The site of OH attack on the lauryl chain is discussed. Similar studies of the interaction of pentyl alcohol and cyclohexanol with sodium lauryl sulphate micelles are reported and discussed in the context of micellar equilibria. The equilibrium constant for pentyl alcohol/ micelle interaction is $K/N = 15\ dm^3\ mol^{-1}$ and for cyclohexanol/micelle, $K/N = 25\ dm^3\ mol^{-1}$.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 16589, 17490, 17492

17192 **(DOE/EV/04115—4) Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.** Adelstein, S.J.; Brownell, G.L. (Massachusetts Inst. of Tech., Cambridge (USA); Harvard Univ., Boston, MA (USA). Shields Warren Radiation Lab.). Oct 1980. Contract AS02-76EV04115. 134p. NTIS, PC A07/MF A01.

Separate abstracts were prepared for the seven progress reports of the Harvard-MIT research program in short-lived radiopharmaceuticals. (KRM)

17193 (DOE/EV/04115—4, pp 6-19) **Studies in technetium chemistry. Progress report.** Jones, A.G.; Davison, A. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

The goal of this research program is to elucidate certain features of the chemistry of technetium which can be exploited in the design of radiopharmaceuticals labeled with the radionuclide Tc-99m. Using the long-lived isotope Tc-99, compounds are being isolated in amounts suitable for characterization by conventional methods of analysis. Progress is reported in the identification of complexes in the (+5), (+4), (+3), (+2), and (+1) oxidation states. Also included are investigations into the use of field desorption mass spectrometry (FDMS) for the analysis of technetium coordination complexes and the use of high pressure liquid chromatography (HPLC) for the purification of these materials.

17194 (DOE/EV/04115—4, pp 19-22) **Design and synthesis of new radiopharmaceuticals.** Davis, M.A.; Hanson, R.N.; Holman, B.L. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

The approach to the development of new imaging agents for the infarcted myocardium is based upon the avidity of organomercurials, in general, and mercurifluoresceins in particular, for necrotic tissue. In previous studies, two series of Hg-203 labeled hydroxymercurated fluoresceins and phthaleins were prepared and evaluated. From these series two agents, Hg-203-hydroxymercurifluorescein (MF) and Hg-203-bis(hydroxy-mercuri) phenolsulfonophthalein (M_2PSP), were considered for further evaluation in dogs. During the last year the more effective of the two agents, MF, was compared to Tc-99m-pyrophosphate for uptake. The labeled organomercurial was inferior to Tc-99m-pyrophosphate. A series of Hg-203 labeled mercurated 9-substituted xanthenes was prepared and evaluated in rats. However, none of these latter compounds demonstrated any greater avidity or selectivity than MF.

17195 (DOE/EV/04115—4, pp 23-35) **Cardiac imaging agents: derivatives of β-adrenergic blocking agents.** Davis, M.A.; Hanson, R.N.; Holman, B.L. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

The goal of this project is the development of radiopharmaceuticals which selectively localize in the normal myocardium and their evaluation for the external detection and sizing of myocardial perfusion defects. The objectives for this year included (a) the preparation and evaluation of radioiodinated practolol analogs and (b) the preparation of /sup 99m/Tc-binding beta antagonists.

17196 (DOE/EV/04115—4, pp 36-44) **Adrenal imaging agents.** Davis, M.A.; Hanson, R.N.; Holman, B.L. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

The goals of this proposal are the development of selenium-containing analogs of the aromatic amino acids as imaging agents for the pancreas and of the adrenal cortex enzyme inhibitors as imaging agents for adrenal pathology. The objects for this year include (a) the synthesis of methylseleno derivatives of phenylalanine and tryptophan, and (b) the preparation and evaluation of radiolabeled iodobenzoyl derivatives of the selenazole and thiazole analogs of metyrapone and SU-9055.

17197 (DOE/EV/04115—4, pp 54-64) **Development and therapeutic application of internally emitting radiopharmaceuticals.** Adelstein, S.J.; Bloomer, W.D. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

This project is concerned with developing the potential of alpha-emitting radionuclides as agents for radiotherapy. Among the available α-emitters, astatine-211 appears most promising for testing the efficacy of α-emitters for therapeutic applications because: (1) it has some chemical similarities to iodine, an element that can readily be incorporated into numerous proteins and peptides; (2) it has a half life that is long enough to permit chemical manipulation yet short enough to minimize destruction of healthy cells; and (3) α-emission is associated with 100% of its decays. If appropriate biological carriers can be labeled with an alpha emitter such as ^{211}At, they could be of great utility in several areas of therapeutic medicine where elimination of specific cell populations is desired. While previous attempts to astatinate proteins using standard iodination techniques have been unsuccessful, effective labeling of proteins with astatine by first synthesizing an aryl astatide and then coupling this compound to the protein via an acylation has been achieved. Undergoing current investigation are several different aryl astatide-followed-by-acylation approaches including an astatinated Bolton-Hunter type reagent using concanavalin A (ConA) and melanocyte stimulating hormone (MSH) as model compounds.

17198 (DOE/EV/04115—4, pp 65-124) **Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C.** Brownell, G.L.; Elmaleh, D.R. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

The overall objective during the period covered by this report was to develop a broad spectrum of radiopharmaceuticals labeled with short-lived cyclotron positron emitters, ^{11}C, ^{13}N and ^{18}F. The goals of the program during the last year were: (1) to complete the modular automated system for important precursor production - formaldehyde, methyliodide, cyanide; (2) to perform animal studies with the ^{18}F-glucose analogues 2FDG and 3FDG and measure the constants for both agents in different animals; and (3) to initiate the development of new fatty acid analogues for the myocardial imaging and metabolism. As part of a collaboration with other groups seeking new agents for myocardium and brain, 9-/sup 123m/Te-telluriumheptadecanoic acid as a myocardial imaging agent was studied. This compound could be used for designing new fatty acid analogues labeled with ^{11}C and ^{18}F that stay in the myocardium because of metabolic inhibition.

17199 **(ORNL/TM—7605) Nuclear medicine technology progress report for quarter ending September 30, 1980.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

Brain uptake of several ^{75}Se- and /sup 123m/Te-labelled barbiturates is being studied. These new agents, substituted at the C-5 position, freely pass through the intact blood-brain barrier. Barbiturates labelled with gamma-emitting radionuclides may be an attractive new class of agents for measurement of regional cerebral blood flow. The diffusion chamber assay system has been used to assess the chronic effects of As_2O_3 toxicity. A small osmotically actuated minipump was used to deliver aqueous As_2O_3 at a continuous delivery rate to animals having intraperitoneally implanted diffusion chambers containing human lung cells (Flow 200). In these preliminary studies, a 49 to 53% inhibition of cell growth was observed over a five-day period when animals received As_2O_3 at a dose of 1.7 to 2 mg (kg-d). These initial studies suggest that the minipump may be a useful means of studying the chronic effects of substances on cell proliferation in conjunction with the diffusion chamber assay system. A microscale synthesis of gold antirheumatoid agents was developed. This method involves reaction of thiohexose derivatives such as thioglucosetetraacetate (β-D-TGTA) with trialkylphosphinegold halide intermediates (R_3PAu-Cl) in the presence of pyridine to give the coupling products $R_3PAu(\beta$-D-TGTA) in good yield (>75%). Using this method, the triethyl analog $Et_3PAu(\beta$-D-TGTA) and triphenyl analog [$ph_3PAu(\beta$-D-TGTA)] have been prepared and characterized.This method will be used to prepare the ^{195}Au-labeled agents. The platinum antitumor agent cis-dichloro-trans-dihydroxy-bis-(isopropylamine)-platinum (IV) (CHIP) has been purified. This system is efficient for separation of CHIP from impurities produced during the synthetic sequence and will be used to prepare /sup 195m/Pt-CHIP for biological evaluation. (ERB)

17200 **(ORO—3602-21) Reactions of charged and neutral recoil particles following nuclear transformations. Final report.** Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry). Dec 1980. Contract AS05-76ER03602. 20p. NTIS, PC A02/MF A01.

A summary is given of the various activities conducted as part of the research on the chemical reactions of energetic particles generated in nuclear reactions. Emphasis was on hot atom chemistry in gases and liquids. A bibliography of 110 publications published as part of the program is included. (DLC)

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 17016, 17355

17201 **(DOE/ER/10677—1) Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981.** Lester, T.W.; Merklin, J.F.; Sorensen, C.M. (Kansas State Univ., Manhattan (USA)). Mar 1981. Contract AC02-80ER10677. 12p. NTIS, PC A02/MF A01.

The opposed co-axial diffusion flame burners have been constructed and preliminary experiments have been conducted, using CO, CH_4 and hydrogen as fuels. The opposed burners are mounted vertically and can be moved independently or in tandem in the vertical direction and can be moved horizontally to facilitate spatial probing, both optical and chemical. Preliminary flame temperature measurements indicate the temperature can be varied by at least 500°K by varying the fuel flowrate and the fuel oxidizer/diluent ratio. A flow regulation system employing critical orifices has been constructed to provide accurate monitoring of the fuel, oxidizer and diluent gases. The critical orifices have been calibrated using helium. The sample probe is being constructed and a number of analytical procedures are being calibrated. The major components of the photon correlation light scattering system have been obtained, tested, and linked together in the experimental configuration. We have scattered light from a simple wicked flame and have obtained good correlation spectra. Preliminary analyses indicated soot particles in 5 to 10 nm range.

17202 (LBL—11650, pp 6.1-6.55) **Combustion research.** Oct 1980.

In Energy and Environment Division annual report, 1979.

Topics covered include: engine combustion, ignition, numerical analysis of hypothetical explosion for the TMI-2 accident, pollutant formation, combustion chemistry, coal combustion, spouted beds, flame propagation, turbulent combustion, vortex flow, boundary layers, fires, polymer combustion, flame radiation, (DLC)

17203 **(PB—80-207970) Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978.** Cernansky, N.P.; Singh, S. (Drexel Univ., Philadelphia, PA (USA). Dept. of Mechanical Engineering and Mechanics). Apr 1979. 60p. NTIS, PC A04/MF A01.

This study examines the effects of probe configuration and combustor operating parameters on NO/NO_2 distributions in flames. A fundamental understanding of physical and chemical phenomena pertinent to NO_2 measurement in combustion systems is important because of the gas's significant role in smog formation and in combustion processes, as well as its hazard to human health. A flat flame burner system was modified, refurbished and optimized for operation over a range of reaction throughputs, fuel-air equivalence ratios, and combustion processes. Comprehensive NO/NOx measurements were made using various probes. Low NO_2 levels were recorded with cooled and uncooled quartz probes; uncooled stainless steel probes showed virtually no differences between NO and NOx; water cooled stainless steel probes measured significant NO_2 concentrations; water cooled sterling silver probe results were similar to those of cooled stainless steel probes. Data indicate that probe configuration, burner pressure, and stoichiometry significantly affect NO/NOx measurements. A kinetic model was developed to clarify and explain sampling probe effects on NO/NO_2 interconversions within the probes.

42 ENGINEERING

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 16553, 16557, 16826, 16856, 17158, 17294, 17324, 17887

17204 **(BDX—613-2560) Gage chucking mechanism. Final report.** Yotter, T. (Bendix Corp., Kansas City, MO (USA)). Feb 1981. Contract AC04-76DP00613. 31p. NTIS, PC A03/MF A01.

Contour gage chucking mechanisms when chucked exert an extraneous force on the contour of parts tested. The evaluation of these forces showed no significant change in part contour and greater repeatability at higher chucking torques. The torque wrench used to torque the gage chucking mechanism, however, was determined to be inaccurate and was replaced with a torque wrench of greater accuracy. The gage is computer operated and provides a printout with test disposition for each part tested.

17205 **(BDX—613-2566) Clean room wiping cloths.** Harding, W.B. (Bendix Corp., Kansas City, MO (USA)). Jan 1981. Contract AC04-76DP00613. 8p. NTIS, PC A02/MF A01.

The suitability of various fabrics for use as clean room wiping cloths was investigated. These fabrics included knit polyester, knit nylon, urethane foam, woven cotton, nonwoven polyester, nonwoven rayon, nonwoven polyethylene and polypropylene, and woven nylon. These materials were tested for detachable lint and fibers, deterioration, and oil content which could leave contaminating films on wiped surfaces. Well-laundered nylon and polyester cloths knitted from filamentary yarn, with hems, were found to be suitable. (LCL)

17206 **(HEDL-SA—2191) Design guides for radioactive-material-handling facilities and equipment.** Doman, D.R.; Barker, R.E. (Hanford Engineering Development Lab., Richland, WA (USA)). 1980. Contract AC14-76FF02170. 18p. (CONF-801107—70). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Fourteen key areas relating to facilities and equipment for handling radioactive materials involved in examination, reprocessing, fusion fuel handling and remote maintenance have been defined and writing groups established to prepare design guides for each areas. The guides will give guidance applicable to design, construction, operation, maintenance and safety, together with examples and checklists. Each guide will be reviewed by an independent review group. The guides are expected to be compiled and published as a single document.

17207 **Device for absorbing mechanical shock.** Newlon, C.E. (to Department of Energy). US Patent 4,241,810. 30 Dec 1980. Filed date 29 Aug 1979. vp.

PAT-APPL-070546.

This invention is a comparatively inexpensive but efficient shock-absorbing device having special application to the protection of shipping and storage cylinders. In a typical application, two of the devices are strapped to a cylinder to serve as saddle-type supports for the cylinder during storage and to protect the cylinder in the event it is dropped during lifting or lowering operations. In its preferred form, the invention includes a hardwood plank whose grain runs in the longitudinal direction. The basal portion of the plank is of solid cross-section, whereas the upper face of the plank is cut away to form a concave surface fittable against the sidewall of a storage cylinder. The concave surface is divided into a series of segments by transversely extending, throughgoing relief slots. A layer of elastomeric material is positioned on the concave face, the elastomer being extrudable into slots when pressed against the segments by a preselected pressure characteristic of a high-energy impact. The compressive, tensile, and shear properties of the hardwood and the elastomer are utilized in combination to provide a surprisingly high energy -absorption capability.

17208 **(LA—8669-MS) Rail gun program.** Fowler, C.M.; Peterson, D.R. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

Rail guns are devices that drive projectiles by electromagnetic forces. Ultimate projectile speeds therefore are not limited by hydrodynamic velocities, as is the case with conventional guns. The two-phase rail gun program is described. In both phases, explosively driven flux compression generators (FCGs) are used to supply power to the guns. In the Los Alamos phase, part of the gun itself is explosively compressed and thus serves as a second-stage FCG. Factors affecting gun performance and projectile acceleration and integrity are discussed. The first experiment in the joint phase of the programs is described. Here, a 12.7-mm lexan cube was accelerated to speed about 3 km/s in a 0.9-m-long gun by currents reaching nearly 600 kA over a time of several hundred microseconds. Although the projectile was stressed to several times its static yield strength during acceleration, it was recovered intact.

17209 **(LA-UR—81-831) Neutralization of H^- beams by magnetic stripping.** Jason, A.J.; Hudgings, D.W.; van Dyck, O.B. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—101). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The stability of H^- beams passing through strong magnetic fields has been relevant to accelerator transport problems and, recently, to neutral beam preparation techniques. The H^- electron detachment rate was measured as a function of rest-frame electric field and provides parameters for a theoretical lifetime expression. The limitations imposed on H^- transport by magnetic stripping, and neutral-beam preparation in emittance growth, magnetic fields, and beam energies are discussed. Application techniques are also briefly discussed.

17210 **Superconducting devices and materials. A literature survey issued quarterly, July-September 1980. Issue No. 80-03.** Olien, N.A. (comp.). Boulder, CO; National Bureau of Standards (1980). 83p. (NP—25340).

This is a cooperative literature survey and review listing publications and reports pertaining to superconducting devices and to theory and experiment related to superconducting devices. Two short reviews of small- and large-scale uses of superconductivity are included in addition to the bibliography.

17211 **(SAND—80-0135) Parameter estimation in structural dynamics models.** Martinez, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 306p. NTIS, PC A14/MF A01.

A method is presented for the estimation of parameters in structural dynamics models. The key features of the method are as follows: estimates are obtained for the intrinsic (physical) parameters of the original model; the procedure is useful for structural dynamics problems limited to medium size, e.g., 1 to 200 degrees of freedom, where only a few, e.g., 1 to 10 key parameters are known; a constrained version of the Discrete, Iterated Extended Kalman Filter for parameter estimation is employed to obtain the estimates, utilizing frequency response function data as the measurements; a slight variation of modal synthesis transformation methods, including reduction of boundary coordinates, is developed to reduce the order of the original model when the frequency response function and its associated partial derivatives are needed for the estimation algorithm; and the magnitude of the frequency response function / H/sub $\alpha\beta/(\omega)$/ is used as data for the estimation procedure. A detailed development of the filter and transformation equations is presented, followed by a discussion of the measurement noise characteristics for the practical case, as well as the simulated data used in the numerical study. Results are given for the several cases of an example problem, demonstrating the effectiveness of the method. Following the conclusions are suggestions for future research.

17212 **(UCID—18750) Diagnostic test systems canister weld joint analysis.** Gerhard, M.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1981. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01.

The Test Systems Section of the Nuclear Test Engineering Division has been developing standard components for its family of canisters. One area of concern in the design has been the weld joints between the main canister channels and the canister endplates. The Solid Mechanics Group of Engineering Mechanics performed numerical calculations on this joint with the SAP4 finite element code and answered the following questions: (1) what is the gross shear stress distribution along the weld; (2) is there a large gradient in stress due to bending; (3) how do the bolts transfer the load from the canister channel through the endplates; and (4) are the bolts equally loaded. The numerical calculations were then compared with experimental results from an experimental pull test. To perform the numerical calculations, the worst-case configuration was chosen from the family of canisters. The geometry modeled was an 86-in. dia canister with a 2.5-in.-thick end ring. The loading condition was a 400-kip canister load (100 kips per channel). The bolts were preloaded to 68 kips. The numerical calculations showed the following: (1) twisting in the endplates that produced a 38-mil separation; (2) a large variation of shear stresses along the welds, varying by a factor of 4 along the upper weld; and (3) an increase in the bolt loads substantially beyond the preload.

17213 **(UCRL—53116) Evaluation of fiber-optic connectors.** Reedy, R.P. (Lawrence Livermore National Lab., CA (USA)). 24 Feb 1981. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01.

Two fiber optic connectors for field use in high efficiency, long distance systems are described and evaluated in this report. The transmission testing arrangement and other considerations are included with the test results. Techniques for optimizing the transmission through these connectors are also described and the results are reported. Many desirable characteristics of connectors for field use are considered and compared to the ITT and Amphenol connectors tested here.

17214 **(Y—2234) Validation of the Monte Carlo criticality program KENO IV and the Hansen-Roach sixteen-energy-group-cross sections for high-assay uranium systems.** Handley, G.R.; Masters, L.C.; Stachowiak, R.V. (Oak Ridge Y-12 Plant, TN (USA)). 10 Apr 1981. Contract W-7405-ENG-26. 87p. NTIS, PC A05/MF A01.

Validation of the Monte Carlo criticality code, KENO IV, and the Hansen-Roach sixteen-energy-group cross sections was accomplished by calculating the effective neutron multiplication constant, k/sub eff/, of 29 experimentally critical assemblies which had uranium enrichments of 92.6% or higher in the uranium-235 isotope. The experiments were chosen so that a large variety of geometries and of neutron energy spectra were covered. Problems, calculating the k/sub eff/ of systems with high-uranium-concentration uranyl nitrate solution that were minimally reflected or unreflected, resulted in the separate examination of five cases.

17215 **(Y—2235) Application of Weibull Criterion to failure prediction in compsites.** Cain, W.D.; Knight, C.E. Jr. (Oak Ridge National Lab., TN (USA)). 20 Apr 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

Fiber-reinforced composite materials are being widely used in engineered structures. This report examines how the general form of the Weibull Criterion, including the evaluation of the parameters and the scaling of the parameter values, can be used for the prediction of component failure.

17216 **Device for emptying liquid nitrogen dewars.** Miller, W.M.; Terris, B.D.; Ginsberg, D.M. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). DE-AC02-76ER01198. *Review of Scientific Instruments, The ;* **52**: No. 4, 611-612(Apr 1981).

We have invented a device for quickly emptying a dewar of liquid nitrogen without having to invert the dewar. The liquid is forced out by compressed nitrogen gas, using a type of pump which does not require the dewar to be sealed.

17217 **Quantum noise theory for the dc SQUID.** Koch, R.H.; Van Harlingen, D.J.; Clarke, J. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Applied Physics Letters ;* **38**: No. 5, 380-382(1 Mar 1981).

The noise temperature of a dc superconducting quantum interference device (SQUID) coupled to a tuned input circuit is computed using the complete quantum expression for the equilibrium noise in the shunt resistance of each junction. At T = 0, where the noise reduces to zero-point fluctuations, the noise temperature for an optimized system is hν/k/sub B/ ln2, where ν is the signal frequency. The computation is extended to nonzero temperatures, and it is shown that a SQUID operated at 1K can approach the quantum limit.

17218 **Adjustable expandable cryogenic piston and ring.** Mazur, P.O.; Pallaver, C.B. (to Department of Energy). US Patent 4,226,169. 7 Oct 1980. Filed date 5 Jun 1978. vp.

PAT-APPL-912784.

The operation of a reciprocating expansion engine for cryogenic refrigeration is improved by changing the pistons and rings so that the piston can be operated from outside the engine to vary the groove in which the piston ring is located. This causes the ring, which is of a flexible material, to be squeezed so that its contact with the wall is subject to external control. This control may be made manually or it may be made automatically in response to instruments that sense the amount of blow-by of the cryogenic fluid and adjust for an optimum blow-by.

17219 **Experimental study of the critical speed response, of a Jeffcot rotor with acceleration.** Hassenpflug, H.L.; Flack, R.D.; Gunter, E.J. (Univ. of Virginia, Charlottesville). Contract AC01-79ET-13151. *Journal of the Franklin Institute ;* **310**: No. 1, 77-88(Jul 1980).

A small, lightly damped rotor (zeta = 0.0088) was experimentally tested for a variety of acceleration and deceleration rates. In each case, the amplitude response was plotted as a function of operating speed, with the acceleration rate considered. In each case the results are compared with theoretical predictions. The results agree within 6% at the peak response. The results of the analysis indicate that for high acceleration rates the critical amplitude response may be reduced by a factor of four or more. The frequency of the effective critical speed may be shifted by up to 20%. Furthermore, a beating frequency was observed in the amplitude data after the rotor had passed through the critical speed. This phenomenon is shown to be the vector sum of a synchronous component of amplitude and a nonsynchronous transient component (at the critical speed). The transient nonsynchronous component is shown explicitly via electronic band-pass filtering, as is the forced response component. Finally, spectral analyses were performed over a range of operating speeds, yielding waterfall diagrams and further verification of the existance of the two components.

4203 Lasers

REFER ALSO TO CITATION(S) 17291, 17559

17220 **(DOE/DP/40070—1) Fluid mechanics of fusion lasers. Final report, September 11, 1978-June 5, 1980.** Shwartz, J.; Kulkarny, V.A.; Ausherman, D.A.; Legner, H.H.; Sturtevant, B. (TRW Systems and Energy, Redondo Beach, CA (USA)). 1980. Contract AC08-78DP40070. 233p. NTIS, PC A11/MF A01.

Flow loop components required to operate continuous-flow, repetitively-pulsed CO_2 and KrF laser drivers for ICF were identified and their performance requirements were specified. It was found that the laser flow loops can have a major effect on the laser beam quality and overall efficiency. The pressure wave suppressor was identified as the most critical flow loop component. The performance of vented side-wall suppressors was evaluated both analytically and experimentally and found capable of meeting the performance requirements of the CO_2 and KrF fusion lasers. All other laser flow loop components are essentially similar to those used in conventional, low speed wind tunnels and are therefore well characterized and can be readily incorporated into fusion laser flow systems designs.

17221 **(UCRL—84260) Coherence in laser excitation.** Shore, B.W. (Lawrence Livermore National Lab., CA (USA)). Feb 1981. Contract W-7405-ENG-48. 47p. (CONF-800432—2). NTIS, PC A03/MF A01.

From 2. international conference on multiphoton processes; Budapest, Hungary (14 Apr 1980).

Noteworthy effects are reviewed that occur in the detailed time dependence of excited-state populations during coherent excitation, as predicted with simplified theoretical modelling of near-resonant N-level excitation by near-monochromatic light. After outlining effects of controllable parameters upon population dynamics, and noting differences between coherent and incoherent excitation, the properties of long-time averages and of multiphoton resonances, and some interesting periodicities are discussed.

17222 **Mercury—ammonia system at high mercury densities.** Mandl, A.; Hyman, H.A. (Avco Everett Research Laboratory, Inc., Everett, Massachusetts 02149). *Journal of Chemical Physics, The ;* **74**: No. 6, 3167-3174(15 Mar 1981).

The properties of optically excited Hg/NH_3 and Hg/ND_3 mixtures have been studied as a function of mercury pressure in the range 1—40 Torr. At low mercury pressures $<$ or $\simeq$1 Torr, the well-known UV emission band due to $HgNH_3^*$ is dominant; this regime has been investigated extensively over the past ten years. However, at higher pressures the UV band disappears and is replaced by a strong green emission band, centered near 500 nm. From a detailed study of the spectral and temporal characteristics

of the green band, it is concluded that it arises from the formation of the $Hg_2NH_3^*$ (or $Hg_2ND_3^*$) excited molecular complex. The lifetime of this exciplex has been measured and is found to be 3.8 μsec (+- 25%). Because of interest in the system as a potential energy storage laser medium, optical transmission measurements have been carried out at selected wavelengths. Net absorption has been observed across the green band at high mercury density, as well as in the UV band in the low density regime.

17223 **Fluence in 1064-nm laser beams: its determination by photography with Polariod film.** Milam, D. (Lawrence Livermore National Lab., CA). Contract W-7405-ENG-48. *Applied Optics ;* **20**: No. 2, 169-171(15 Jan 1981).

Exposure fluences that have been measured with 1064-nm pulses having duratio ns from 0.15 ns to 50 ns are presented and the use of Polariod film as an absolute diagnostic is discussed.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 16865

17224 **(BNL—29189) Overview of multifluid-flow-calculation methods.** Stewart, H.B. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 13p. (CONF-810234—1). NTIS, PC A02/MF A01.

From Army Research office workshop on multiphase flow; Aberdeen Proving Ground, MD, USA (2 Feb 1981).

Two categories of numerical methods which may be useful in multiphase flow research are discussed. The first category includes methods which are specifically intended for accurate computation of discontinuities, such as the method of characteristics, particle-in-cell method, flux-corrected transport, and random choice methods. Methods in this category could be applied to research on rocket exhaust plumes and interior ballistics. The second category includes methods for smooth, subsonic flows, such as fractional step methods, semi-implicit method, and methods which treat convection implicitly. The subsonic flow methods could be of interest for ice flows. (LCL)

17225 **(CONF-810434—2(Draft)) Measurement of transient two-phase flow velocity using statistical signal analysis of impedance probe signals.** Leavell, W.H.; Mullens, J.A. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 38p. NTIS, PC A03/MF A01.

From 2. international symposium on flow; St Louis, MO, USA (6 Apr 1981).

A computational algorithm has been developed to measure transient, phase-interface velocity in two-phase, steam-water systems. The algorithm will be used to measure the transient velocity of steam-water mixture during simulated PWR reflood experiments. By utilizing signals produced by two, spatially separated impedance probes immersed in a two-phase mixture, the algorithm computes the average transit time of mixture fluctuations moving between the two probes. This transit time is computed by first, measuring the phase shift between the two probe signals after transformation to the frequency domain and then computing the phase shift slope by a weighted least-squares fitting technique. Our algorithm, which has been tested with both simulated and real data, is able to accurately track velocity transients as fast as 4 m/s/s.

17226 **(DOE/ER—03077-170) Unsteady transonic flow past airfoils in rigid-body motion.** Chang, I.C. (New York Univ., NY (USA). Courant Mathematics and Computing Lab.). Mar 1981. Contract AC02-76ER03077. 202p. NTIS, PC A10/MF A01.

With the aim of developing a fast and accurate computer code for predicting the aerodynamic forces needed for a flutter analysis, some basic concepts in computational transonics are reviewed. The unsteady transonic flow past airfoils in rigid body motion is adequately described by the potential flow equation as long as the boundary layer remains attached. The two dimensional unsteady transonic potential flow equation in quasilinear form with first order radiation boundary conditions is solved by an alternating direction implicit scheme in an airfoil attached sheared parabolic coordinate system. Numerical experiments show that the scheme is very stable and is able to resolve the higher nonlinear transonic effects for filter analysis within the context of an inviscid theory.

17227 **(KAPL—4139) Discrete-pressure equations in incompressible-flow problems.** Wachspress, E.L. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Jan 1981. Contract AC12-76SN00052. 18p. (CONF-810132—1). NTIS, PC A02/MF A01.

From IIMASS workshop on numerical analysis; Mexico City, Mexico (12 Jan 1981).

Consistent integration of flow divergence and pressure gradient terms over interlocking mesh boxes preserves properties that enhance stability and convergence of discretized Navier-Stokes equations over regions partitioned with isoparametric quadrilaterals.

4205 Materials Testing

17228 **(RFP—3198) Assessment of available small deep hole inspection methods.** Burnham, M.W. (Rockwell International Corp., Golden, CO (USA). Energy Systems Group). 1981. Contract AC04-76DP03533. 9p. (CONF-810427—2). NTIS, PC A02/MF A01.

From SME international tool and manufacturing engineering conference and exposition; Detroit, MI, USA (27 Apr 1981).

Features needing inspection on small diameter deep holes are discussed. The relation of hole diameter to the limits of measurement ability by several techniques is then related to those features. In general it is shown that as the hole diameter approaches 0.020 inch and smaller, the amount of detail measurable and the features which can be evaluated becomes severely restricted using non-destructive techniques.

17229 **Technique for measurement of fast exponentially-decaying signals.** Garver, W.P. (Department of Physics, University of Missouri-St. Louis St. Louis, Missouri 63121). DE-AS02-76-ER02718. *Review of Scientific Instruments, The ;* **52**: No. 4, 607-608(Apr 1981).

An accurate yet inexpensive technique for measuring time constants of fast exponentially-decaying signals is described. Two discriminators are set at different levels and the difference between the corresponding triggering times gives the time constant.

17230 **Lens design and local minima.** Brixner, B. (University of California, Los Alamos Scientific Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Applied Optics ;* **20**: No. 3, 384-387(1 Feb 1981).

The widespread belief that local minima exist in the least squares lens-design error function is not confirmed by the Los Alamos Scientific Laboratory (LASL) optimization program. LASL finds the optimum-mimimum region, which is characterized by small parameter gradients of similar size, small performance improvement per iteration, and many designs that give similar performance. Local minima and unique prescriptions have not been found in many-parameter problems. The reason for these absences is that image errors caused by a change in one parameter can be compensated by changes in the remaining parameters. False local minima have been found, and four cases are discussed.

17231 **Mosaic of coded aperture arrays.** Cannon, T.M.; Fenimore, E.E. (to Department of Energy). US Patent 4,228,420. 14 Oct 1980. Filed date 14 Sep 1978. vp.

PAT-APPL-942228.

The present invention pertains to a mosaic of coded aperture arrays which is capable of imaging off-axis sources with minimum detector size. Mosaics of the basic array pattern create a circular on periodic correlation of the object on a section of the picture plane. This section consists of elements of the central basic pattern as well as elements from neighboring patterns and is a cyclic version of the basic pattern. Since all object points contribute a complete cyclic version of the basic pattern, a section of the picture, which is the size of the basic aperture pattern, contains all the information necessary to image the object with no artifacts.

17232 **Single crystal metal wedges for surface acoustic wave propagation.** Fisher, E.S. (to Dept. of Energy). US Patent Application 148,313. 9 May 1980. 13p.

An ultrasonic testing device has been developed to evaluate flaws and inhomogeneities in the near-surface region of a test material. A metal single crystal wedge is used to generate high frequency Rayleigh surface waves in the test material surface by conversion of a slow velocity, bulk acoustic mode in the wedge into a Rayleigh wave at the metal-wedge test material interface. Particular classes of metals have been found to provide the bulk acoustic modes necessary for production of a surface wave with extremely high frequency and angular collimation. The high frequency allows flaws and inhomogeneities to be examined with greater resolution. The high degree of angular collimation for the outgoing ultrasonic beam permits precision angular location of flaws and inhomogeneities in the test material surface.

4206 Safety Engineering

17233 **Red-tagging safety procedure for a steam distribution system.** Sinnott, M.V. (Boston Edison Co., MA). pp 34, Section 20 of Proceedings of the International District Heating Association. Volume 71. Washington, DC; International District Heating Association (1980).

From 71. annual conference of the International District Heating Association; Harbor Springs, MI, USA (23 Jun 1980).

Safety procedures used by the Boston Edison Co. to protect personnel and equipment from damage due to malfunctioning or nonfunctioning equipment in steam distribution systems are explained. These procedures, called Red Tagging, involve attaching red tags, labelled with location, time, etc. information, to switches, valves, controls, and operating handles in order to alert operating and maintenance personnel to not operate these controls until problems in the steam distribution have been corrected. Each step in the procedure is itemized. (LCL)

4207 Vacuum Engineering

REFER ALSO TO CITATION(S) 17262

17234 **(GEPP-OP—563) Pumping-speed-measurement techniques for getters.** Mehrhoff, T.K.; Barnes, L.W. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 1981. Contract AC04-76DP00656. 37p. (CONF-810236—1). NTIS, PC A03/MF A01.

From 10. annual symposium on applied vacuum science and technology; Tampa, FL, USA (9 Feb 1981).

The useful pumping speed of getters may vary significantly for the various types used and their particular application. Two measurement techniques for measurement of fast and slow gettering rates are described. The measurement technique for rapid gettering (0.5 to 9 1/s) is a dynamic method. Here the getter is activated under vacuum while pumping in competition with a reference vacuum pump of known pumping speed and conductance. Gas flow is maintained with a calibrated leak in the 10^{-6} cc/s range. The gas flow to the reference pump is monitored by a continuous scanning quadrupole mass spectrometer. Gas which is not pumped by the reference pump is pumped by the getter sample. The example used is an erbium thin film getter pumping on carbon dioxide for temperatures between 300 and 900°C. Sticking coefficients were determined and plotted as a function of Langmuirs of carbon dioxide exposure. The static method is used for measurement of slower pumping rates (10^{-2} to 10^{-5} 1/s). This technique involved activating the getter and exposing it to a closed chamber of gas in the micron region. The gas in the chamber is monitored by opening a low conductance orifice to a pump and mass spectrometer for a few seconds at intervals of approximately two hours. The example given is a flashless getter powder in a porous stainless steel sheath pumping at ambient temperature. Pumping speed and capacity data are given for hydrogen, carbon dioxide, nitrogen and carbon monoxide.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 17279, 17289, 17299

17235 **(BDX—613-2507) Laser machining of ceramic.** Laudel, A. (Bendix Corp., Kansas City, MO (USA)). 1980. Contract AC04-76DP00613. 10p. (CONF-801139—2). NTIS, PC A02/MF A01.

From Electro-optics/laser conference; Boston, MA, USA (19 Nov 1980).

The Kansas City Division of The Bendix Corporation manufactures hybrid microcircuits (HMCs) using both thin film and thick film technologies. Laser machining is used to contour the ceramic substrates and to drill holes in the ceramic for frontside-backside interconnections (vias) and holes for mounting components. A 1000 W CO_2 type laser is used. The laser machining process, and methods used for removing protruding debris and debris from holes, for cleaning the machined surfaces, and for refiring are described. The laser machining process described consistently produces vias, component holes and contours with acceptable surface quality, hole locations, diameter, flatness and metallization adhesion. There are no cracks indicated by dipping in fluorescent dye penetrant and the substances are resistant to repeated thermal shock.

17236 **(BDX—613-2551) Finite-element-method study of stresses on simulated electronic components encapsulated in polystyrene-bead foam.** Swanson, G.D. (Bendix Corp., Kansas City, MO (USA)). Mar 1981. Contract AC04-76-DP00613. 24p. NTIS, PC A02/MF A01.

As part of an encapsulant evaluation for a high voltage electronic assembly, the linear elastic finite element method computer code SASL was used to calculate the stress distribution in an axisymmetric solder joint under load. A simulated electronic component in the form of a thumb tack was used as a physical model to calculate lead wire loads when encapsulated in 0.6 g/cm^3 polystyrene bead form. The calculated lead wire loads disagreed with previous experimental data. Reanalysis of those data revealed nonlinear effects which were not adequately modeled in the SASL calculation.

17237 **(BDX—613-2598) Etchback smear removal process characterization. Final report.** Richardson, J.H. (Bendix Corp., Kansas City, MO (USA)). Mar 1981. Contract AC04-76DP00613. 15p. NTIS, PC A02/MF A01.

A study evaluated variable limits for each chemical solution used in etchback smear removal on multilayer printed wiring boards (MLPWBs) to determine variables' influence on etchback behavior. Etchback smear removal is essential to fabricate about 40 different multilayer parts. However, erratic etchback behavior contributes to reduced yields among multilayer parts. The study, conducted on 172 multilayer printed wiring boards in 43 test runs, indicated that chemical interaction may not be a principal influence on etchback behavior. Study results also indicated that slight changes in process variables did not influence the presence of recessed conductors. The results verified the adequacy of existing tolerances on main process variables to produce uniformly etched holes.

17238 **(UCRL—50025-80-3) Electronics Engineering Department. Quarterly report No. 3, 1980.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Dec 1980. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

Activities with the electronics engineering department of Lawrence Livermore National Laboratory are reported with information on: the use of microcomputers to perform mundane tasks, in large computer systems, the Computer Automated Measurement and Control (CAMAC) test facility for verifying the performance of CAMAC modules and crates; the design and operation of a micro-processor-controlled isocon camera that can span the output phosphor of a streak camera located 2000 ft from the camera control; and the design and operation of the Design Automation System (DASLL), which is a system of computer programs that automatically lays out printed circuit boards.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 16393, 16958, 17003, 17016, 17034, 17386

17239 **(CONF-801104—13) Effect of bed and jet parameters on vertical jet penetration length in gas fluidized beds.** Hirsan, I.; Sishtla, C.; Knowlton, T.M. (Institute of Gas Technology, Chicago, IL (USA)). 1980. Contract AC21-78ET11330. 45p. NTIS, PC A03/MF A01.

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

An experimental study was conducted to determine the effect of both jet and bed parameters on vertical jet penetration length in a fluidized bed. Tests were conducted at ambient temperature in a 12-inch-diameter (0.35 m) semicircular column fitted with a transparent faceplate. Based on the experimental data, an empirical correlation was developed to predict jet penetration. This correlation was compared with the results reported by other investigators in the field.

17240 **(DOE/PC/30214—T1) Heat transfer to tubes in freeboard space of fluidized bed combustors. Progress report, August 1, 1980-January 31, 1981.** Chen, J.C.; Biyikli, S. (Lehigh Univ., Bethlehem, PA (USA)). Feb 1981. Contract FG22-80PC30214. 12p. NTIS, PC A02/MF A01.

The existing room temperature fluidized bed facility was modified to carry out tests at high flow rates. Tests were carried out to determine the effect of increase in humidity of air on heat transfer coefficients. At low air flow rates, where the static charge effect is low, data without injection of steam were compared with the results for the same flow rates with steam injection. Increasing relative humidity to 65 percent changed the heat transfer coefficient by less than 2 percent. There are several investigations on heat transfer behavior of tubes in the submerged region, some of which are given in the references quoted. The data are mostly at low gas flow rates. Fluidized bed combustion operation calls for high gas flow rates. There are not enough data on heat transfer behavior of tubes in submerged region for high gas flow rates to compare with the anticipated results of this project in freeboard region at high flow rates. For this reason, the first tests were carried out with a submerged horizontal tube at midpoint of an 18 inch high static bed at room temperature. The test particles were 300 μm and 850 μm mean diameter glass beads. The maximum superficial gas velocity, U/sub sg/, for 300 μm mean diameter particles was 3.5 m/sec. At these high gas velocities, local and circumferentially averaged heat transfer coefficients were measured. They are tabulated in Tables. To better visualize the variation heat transfer coefficient as a function of superficial gas velocity, they are plotted. The variation of local heat transfer coefficient around the tube at different gas flow velocities is also shown.

17241 **Method of regulating the amount of underfire air for combustion of wood fuels in spreader-stoker boilers.** Tuttle, K.L. (to Department of Energy). US Patent 4,241,672. 30 Dec 1980. Filed date 4 Dec 1978. vp.

PAT-APPL-966523.

A method of metering underfire air for increasing efficiency and reducing particulate emissions from wood-fire, spreader-stoker boilers is disclosed. A portion of the combustion air, approximately one pound of air per pound of wood, is fed through the grate into the fuel bed, while the remainder of the combustion air is distributed above the fuel in the furnace, and the fuel bed is maintained at a depth sufficient to consume all oxygen admitted under fire and to insure a continuous layer of fresh fuel thereover to entrap charred particles inside the fuel bed.

4230 Marine Engineering

17242 **European offshore steels research seminar.** Abington, England; Welding Inst. (1980). 689p. (CONF-7811182—).

From European offshore steels research seminar; Cambridge, UK (27 Nov 1978).

The papers and summaries are presented under the following session headings: brittle fracture and steel selection, fatigue of welded joints, corrosion fatigue of welded joints, experimental studies of crack growth, interpretation and prediction of crack growth, stress analysis of tubular joints, and testing of tubular joints. (DLC)

4240 Pollution Control Equipment

17243 **(PB—80-211386) Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980.** Carter, W.A.; Buening, H.J. (KVB, Inc., Irvine, CA (USA)). Apr 1980. Contract EPA-68-02-2645. 213p. NTIS, PC A10/MF A01.

This is a final report for a test program to evaluate the long-term effectiveness of combustion modifications on industrial boilers. Previous short-term tests had been performed on industrial boilers to determine the effect of combustion modifications on air pollutant emissions such as NOx, SOx, CO, HC, and particulate. The objective of this program was to determine if the combustion modification techniques which were effective for the short-term tests are feasible for longer periods. The report gives results of a 30-day field test of a 29.3 MW output (100,000 lb steam/hr) coal-fired spreader stoker. Low excess air was used to control NOx emissions. Results indicate that low excess air firing is an effective long-term NOx control for spreader stokers. The as-found NOx concentration was 243.9 ng/J (400 ppm at 3% O_2, dry) with the boiler load at 80% of design capacity. Firing in the low excess air mode reduced the as-found condition by about 20%. Low excess air firing also increased efficiency by about 3%.

17244 **(PB—80-212939) Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 2. Appendices. Final report, March 1977-May 1978.** Lim, K.L.; Waterland, L.R.; Castaldini, C.; Chiba, Z.; Higginbotham, E.B. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Apr 1980. Contract EPA-68-02-2160. 208p. NTIS, PC A10/MF A01.

The report gives results of an evaluation of combustion modification techniques for coal-, oil-, and gas-fired utility boilers, with repect to NOx control reduction effectiveness, operational impact, thermal efficiency impact, capital and annualized operating costs, and effect on emissions of pollutants other than NOx. For gas- and oil-fired boilers, 30 to 60% NOx reductions are achievable with the combined use of staged combustion, flue gas recirculation and low excess air at an annualized cost of $0.50 to $3.00/kW-yr. For retrofit control of existing coal-fired boilers, low NOx burners and/or staged combustion yields a 30 to 60% NOx reduction at an annualized cost of $0.40 to $1.20/kW-yr. For new sources, modified furnace design with low NOx burners and/or overfire air can achieve emission levels of 260 to 170 ng/J (40 to 60% reduction). Detailed emission tests on a 200 MW coal-fired boiler showed that changes in trace specie emissions due to combustion modifications were small compared to the benefit of reduced NOx emissions.

17245 **(PB—80-215734) Preliminary environmental assessment of afterburner combustion systems. Final report, March 1977-June 1980.** Barrett, R.E.; Sticksel, P.R. (Battelle Columbus Labs., OH (USA)). Jun 1980. Contract EPA-68-02-2629. 125p. NTIS, PC A06/MF A01.

The report gives results of an environmental assessment of afterburner control systems (fume incinerators). It consisted of a review of available data and literature, and the planning of a subsequent experimental program, intended to consist of laboratory and/or field emission measurements to provide data not presently available. The report describes the use of existing data to estimate the potential national usage of afterburners based on emissions. It also reports on an evaluation of field tests data from the files on one local air pollution control agency. Results of the analyses show that the average efficiency of in-service afterburners may be significantly less than that reported in much of the literature.

17246 **(PB—80-219512) Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980.** Carter, W.A.; Buening, H.J. (KVB, Inc., Irvine, CA (USA)). Apr 1980. Contract EPA-68-02-2645. 159p. NTIS, PC A08/MF A01.

This is a final report for a test program to evaluate the long-term effectiveness of combustion modifications for lowering emis-

sions from industrial boilers. Previous short-term test had been performed on industrial boilers to determine the effect of combustion modifications on such air pollutant emissions as NOx, SOx, CO, HC, and particulate. The objective of this program was to determine if the combustion modification techniques which were effective for the short-term tests are feasible for longer periods. The report gives results of a 30-day field test of a pulverized-coal-fired, water-tube boiler rated art 76.2 MW (260,000 lb steam/hr) output. Staged combustion air and low excess air were used to effectively control NOx emissions. However, such additional operational problems as flame instability can be encountered. The baseline NO measurement was 498 ng/J (815 ppm at 3% O2, dry) with the unit operating at about 70% of capacity. At the same load low NOx operations yielded NO at an emission level of 422 ng/J (691 ppm at 3% 02, dry) for a 15% NO reduction. During 30 days of firing under low NOx operation with loads of 15 to 63 MW, the average NO emission level was 340 ng/J (557 ppm at 3% O2, dry). Boiler efficiency increased about 1% under low NOx firing conditions.

17247 **(PB—80-219520) Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980.** Carter, W.A.; Hart, J.R. (KVB, Inc., Irvine, CA (USA)). Apr 1980. Contract EPA-68-02-2645. 178p. NTIS, PC A09/MF A01.

This is a final report for a test program to evaluate the long-term effectiveness of combustion modifications on industrial boilers. Previous short-term tests had been performed on industrial boilers to determine the effect of combustion modifications on such air pollutant emissions as NOx, SOx, CO, HC, and particulate. The objective of this program was to determine if the combustion modification techniques which were effective for the short-term tests are feasible for longer periods. The report gives result of a 30-day field test of a 38.1 MW (130,000 lb steam/hr) output coal-fired spreader stoker. Low excess air was used to control NOx emissions. Results indicate that low excess air firing is an effective long-term NOx control for spreader stokers. The as-found NOx concentration was 240 ng/J (409 ppm at 3% O2, dry) with the boiler load art 80% of design capacity. Firing in the low excess air mode reduced the as-found condition by about 19%. Low excess air firing also increased efficiency by about 1.2% and decreased particulates by about 22%.

17248 **(PB—80-219587) Multi-fuel low-NO/sub x/ burner development. Phase I. Final report, November 1978-March 1980.** Waibel, R.T. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1980. Contract GRI-5011-342-0091. 32p. NTIS, PC A03/MF A01.

A comprehensive search of the literature was conducted to obtain information regarding recent developments in the control of NOx emissions by combustion modification. Most research on control of NOx by modifications to the combustions system has addressed utility boiler applications. This information was analyzed, and burner designs were formulated for application to industrial process heating. Thirty-four burner manufacturers were also contacted to determine the availability of low-NOx burners. Eight manufacturers indicated that they were employing low-excess air as an NOx control method, and two manufacturers indicated that they were working on burners employing more sophisticated control methods. Ten of the manufacturers expressed interest in participating in a program to develop low-NOx burners for various industrial processes.

4250 Power Cycles

REFER ALSO TO CITATION(S) 17012

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 17743

17249 **(LA-UR—81-818) New applications of particle accelerators in medicine, materials science, and industry.** Knapp, E.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810314—104). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Recently, the application of particle accelerators to medicine, materials science, and other industrial uses has increased dramatically. A random sampling of some of these new programs is discussed, primarily to give the scope of these new applications. The three areas, medicine, materials science or solid-state physics, and industrial applications, are chosen for their diversity and are representative of new accelerator applications for the future.

17250 **Current limits in linear accelerators.** Reiser, M. (Electrical Engineering Department and Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics ;* **52**: No. 2, 555-563(Feb 1981).

In recent years considerable interest has developed in the use of linear accelerators for various high-current applications (radiation testing facilities, neutron spallation sources, heavy-ion fusion, etc.). The beam dynamics and current limits in a linear accelerator are determined largely by the periodicity and phase-space acceptance of the external focusing system and the particle oscillation frequencies (or phase shifts per focusing period), both without the space-charge forces and with the space-charge forces of the particle bunch. General formulas for the transverse and longitudinal current limits in terms of these fundamental quantities are derived. The relationships with the actual accelerator and particle beam parameters are examined for strong (quadrupole) and weak focusing field configurations. As a practical illustration, the results are applied to a drift-tube linac with quadrupole focusing in the transverse direction and rf phase focusing in the longitudinal direction.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 17272, 17281, 17288, 17296

17251 **(BNL—29201) Spiral design and beam dynamics for a variable energy cyclotron.** Baltz, A.J.; Chasman, C.; Thorn, C.E. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 4p. (CONF-810314—67). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Beam-orbit studies were performed for the conversion of the SREL synchrocyclotron magnet for use as a room temperature, multiparticle, isochronous cyclotron. Based on model magnet measurements of field profiles for 8 to 23°K gauss hill fields, a four sector spiral pole tip design has been realized which allows all isotope species of heavy ion beams to be accelerated to required final energies. The total spiral angle of 38° allows injection of the beams from the MP tandem into the cyclotron through a valley. The two valey RF system of 140 kV peak accelerates beams on harmonic numbers 2, 3, 4, 6 and 10 at 14 to 21 MHz. Computer calculations indicated acceptable ν/sub z/, ν/sub r/ and phase space beam characteristics and passing of resonances for typical beams considered: ^{16}O at 8 and 150 MeV/amu, ^{60}Ni at 100 MeV/amu and ^{238}U at 2.5 and 16 MeV/amu. Single turn extraction is achieved with electrostatic deflection.

17252 **(BNL—29211) Edge focusing.** Galayda, J.N. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 2p. (CONF-810314—77). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Beam transport matrix elements describing the linearly faling fringe field of a combined function bending magnet are expanded in powers of the fringe field length by iteratively solving the integral form of Hill's equation. The method is applicable to any linear opti-

cal element with variable focusing strength along the reference orbit. Results for the vertical and horizontal focal lengths agree with previous calculations for a zero gradient magnet and an added correction to the dispersion is found for this case. A correction to the fringe field gradient peculiar to a combined-function magnet with strong edge focusing is also found. The influence of edge focusing on the tunes and chromaticities of the NSLS rings is described. The improved chromaticity calculation for the booster was of particular interest since this ring has bending magnets with pole-tips shaped to achieve small positive chromaticities.

17253 **(BNL—29212) Inhomogeneities in magnetic field due to variations of lamination gap heights.** Galayda, J.N.; Heese, R.N.; Krinsky, S. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—71). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

It is difficult and expensive to maintain stringent tolerances on the variation in gap heights of dipole magnet laminations. Using the perturbation technique of K. Halbach, whereby one approximates a deformation of a magnet pole tip by a change of the scalar potential on the undeformed pole, the tolerance necessary to achieve a given homogeneity of the magnetic field was calculated. Tolerances may be significantly relaxed if a systematic shuffling scheme is used to minimize the lamination variations averaged over a distance small compared to the gap height. Results of the calculations are compared with data from field measurements on the bending magnets for the NSLS 700 MeV Ring, for which laminations were carefully shuffled, and for the corresponding prototype magnet which was not shuffled. For magnets used in storage rings, very tight gap height tolerances are not necessary, because field variations are reduced by shuffling and significantly cancel out when integrated over the magnet.

17254 **(BNL—29215) Vertical fast blow-up in a single bunch.** Ruth, R.D.; Wang, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—69). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Vertical coherent instabilities in bunched beams are studied with an emphasis on single bunch instabilities in which the growth time is less than the period of synchrotron oscillations. Single bunch instabilities have been studied by many people, however, in most treatments the standard assumption is that the coherent force can be treated as a perturbation compared to the synchrotron force. This simplifies the problem greatly since in this way an individual synchrotron mode is decoupled (or coupled only to a neighboring mode). In the regime of fast blow-up (growth time $<$ synchrotron period) this assumption is not valid, and it is therefore necessary to include the coupling of all the synchrotron modes.

17255 **(BNL—29295) Acceleration of polarized protons in the Brookhaven AGS.** Terwilliger, K.M.; Crabb, D.G.; Krisch, A.D. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—83). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A multi-laboratory-university collaborative project involving Argonne, Brookhaven, Michigan, Rice and Yale is underway to accelerate polarized protons at the AGS. The success of the now turned off 12 GeV/c ZGS polarized beam and the design studies for the AGS made us confident of the feasibility of achieving a polarization of about 60% at 26 GeV/c with an intensity 10^{11} to 10^{12} protons/pulse. Such a beam would be a potential source of polarized protons for ISABELLE. This report gives a brief discussion of the overall project and describes the tests of a prototype of the fast pulsed ferrite quadrupole magnets which will jump the intrinsic depolarizing resonances.

17256 **(DOE/ER/40014—1) Numerical calculation of the three dimensional electrical field in the central region of a cyclotron.** Chen, M.; Lind, D.A. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). 1981. Contract AC02-81ER40014. 3p. (CONF-810314—39). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

To provide detailed and accurate electric fields in the ion source-puller region and at the dee dummy-dee gap for a cyclotron, a relaxation method solution of Laplace's equation has been used. A conventional difference equation with variation in mesh size and relaxation factor as well as different schemes for boundary corrections have been developed to achieve roughly 1 percent accuracy for a thre-dimensional domain with 10^6 mesh points. Although the computation requires considerable computer time, it is much less expensive than electrolytic tank analogue methods for measuring field distributions around complex electrode configurations.

17257 **(LA-UR—81-730) LAMPF dual-energy operation.** Hagerman, D.C.; Hill, R.E.; Hunter, W.T.; Macek, R.J.; van Dyck, O.B. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-810314—87). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The Los Alamos Meson Physics Facility (LAMPF) operated with simultaneous H^+ and H^- beams until June 1980, when a method of providing a variable energy H^- beam as well as a full-energy H^+ beam was brought into use. The scheme is based on time sharing between H^+ and H^- beam pulses. It is now possible to provide H^- beams with energy as low as 300 MeV along with the usual 800-MeV H^+ beams. The method requires a reduction in duty factor of the H^+ and H^- beams; however, the total duty factor has been increased to 9% which compensates in large measure for the reduction due to dual-energy operation. The necessary modifications to the beam switchyard and accelerator timing systems are described.

17258 **(LA-UR—81-737) Redesign of the LAMPF transition region.** Sander, O.; Browman, A.; Bush, E. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—88). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The redesign of the transition region (TR) that functions as a transport section for the H^+ and H^- beams between the LAMPF 201.25-MHz drift-tube (DT) and 805-MHz side-coupled (SC) linacs providing a 7.98 cm longer flight path for one beam so that both beams have the correct phase for capture in the SC linac is described. In the new TR both beams from the DT linac are independently matched to the acceptance of the SC linac. The relative phase adjustment between the two beams has been simplified and is now accomplished with just one control. A straight-through section has been added to facilitate beam studies under less complicated conditions. The aperture has been increased to reduce beam losses. Diagnostic equipment allows measurement of the transverse output emittance of the DT linac. We discuss both the criteria placed upon the beam in the TR and the predicted performance in matching a variety of beam shapes from the DT linac to a variety of SC accelerator acceptance shapes.

17259 **(LA-UR—81-784) Los Alamos proton-storage-ring extraction system.** Hudgings, D.W.; Jason, A.J. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—102). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The unprecedented peak and average proton currents and extraction rates from the Proton Storage Ring (PSR) under construction at the Los Alamos National Laboratory present new problems in beam extraction. Activation caused by beam spill must be minimal to permit hands-on maintenance. Timing requirements are uncommonly stringent. Solutions to these problems are outlined below.

17260 (LBL—10757) Stochastic cooling of 200 MeV protons. Lambertson, G.; Bisognano, J.; Flood, W.; Laslett, L.J.; Leemann, C.; Leskovar, B.; Lo, C.C.; Main, R.; Smith, L.; Staples, J. (Lawrence Berkeley Lab., CA (USA)). Jul 1980. Contract W-7405-ENG-48. 6p. (CONF-800740—27). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

Vertical and longitudinal cooling has been achieved at the FNAL 200 MeV cooling ring. Initial longitudinal cooling times of 20 seconds for 1.5 x 10^6 circulating protons are in approximate agreement with calculations based on measured system parameters. The cooling systems have an electronic bandwidth of ~ 300 MHz, travelling wave pickups and kickers and a notch filter using flexible cable. The TW structures provide a good signal-to-noise ratio and reduce output power requirements.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 17253, 17287, 17295, 17299, 17304

17261 (BNL—29083) Improved copper septum magnet design. Rodger, E.S.; Weisberg, H.L. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 1p. (CONF-810314—78). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A copper septum magnet of improved design has been developed to replace the existing F5 septum deflector in the slow-extraction channel at the Brookhaven National Laboratory AGS. The new magnet has several novel design features such as a solid rather than laminated core, a ball bearing suspended septum and a radiation resistant quick disconnect system.

17262 (BNL—29148) Leak checking in ISABELLE. Briggs, J.; Halama, H.J. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—92). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The Intersecting Storage Accelerator (ISABELLE) contains two completely independent vacuum systems. One known as Beam Vacuum operates at 1 x 10^{-11} Torr and maintains a very clean environment for the circulating proton beam. The other system known as Insulating Vacuum maintains superconducting magnet vessels at a pressure below 1 x 10^{-6} Torr. In this system all gasses except helium are cryocondensed on the cold surfaces of superconducting magnets and cryogenic circuits. Turbomolecular pumps pump the inadvertent small helium leaks. The helium background both in the MagCOOL area and in the ISABELLE tunnel limits the sensitivity of conventional leak detectors. Leak detection in ISABELLE is one of the most important functions, since there are thousands of bellows and welds operating at 4 K and at 15 atmosphere pressure and that many welds can only be leak checked at room temperature. Leak rates are known to increase by 4 orders of magnitude when cooled from 300 K to 4 K. Thus the required 10^{-10} Torr liters s^{-1} sensitivity is essential for proper operation and methods and equipment which permit the location of such leaks in large systems have been developed and tested on the First Cell and the refrigerators. They produced a completely leak free system, i.e. the helium background did not change when all pumps were closed for 24 hours. These methods and the equipment are discussed in detail.

17263 (BNL—29174) Tests of a 3 meter curved superconducting beam transport dipole magnet. Allinger, J.E.; Carroll, A.S.; Danby, G.T.; DeVito, B.; Jackson, J.W.; Leonhardt, W.J.; Prodell, A.G.; Weisenbloom, J. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—80). NTIS, PC A03/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Initial tests of one of the curved 3 m long superconducting dipole magnets intended to generate 6.0 T and produce a 20.4° bend in the primary proton beam to a new D-target station at the Brookhaven National Laboratory AGS have been completed. Although this magnet, whose window frame design generally follows that of the successful 8° and Model T superconducting dipoles, demonstrates many of the desirable characteristics of these earlier magnets such as excellent quench propagation and good ramping properties, it has only reached a disappointingly low magnetic field of 3.5 to 4.0 T. Because of the great interest in superconducting magnet technology, this report will describe the diagnostic tests performed and plans for future modifications.

17264 (BNL—29176) New AGS slow external beam switchyard. Brown, H.; Brown, R.; Chimienti, L. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—79). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The original switchyard for the Slow External Proton Beam at the AGS of Brookhaven National Laboratory incorporated two current carrying, copper septa to split the beam into three parts. These septa were each .05 mm thick and intercepted a substantial amount of beam when, as often occurs, it was necessary to split the beam across its densest region. To adjust splitting ratios and optimize losses, a complex time consuming pattern of steering adjustments using various magnets was necessary. When the question of providing a fourth beam to a new target station arose, it was clear that adding a third copper septum in the very constrained space available would lead to unacceptable increases in the radiation and control problems. In order to circumvent these difficulties, it was decided to rebuild the switchyard using much thinner electrostatic septa as splitters and to provide a greater degree of independence of the various beam segments.

17265 (BNL—29187) AGS fast kicker magnet system. Weng, W.T.; Cottingham, J.G.; Foelsche, H.; Frey, W.; Ghoshroy, S.; Schmidt, C.; Tuozzolo, J. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—75). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A new fast extraction system from the AGS will be implemented to improve the neutrino beam and to serve for ISABELLE injection. The fast kicker for the system is of an open C-type design with a field strength of 1.25 kG at 2650 amperes. The pulser system is a mismatched, discharge type PFN which is capable of delivering a pulse of 3000 amperes peak current at 30 kV dc, with a 2.7 μsec pulse width, 170 nsec rise time, and flat top ripple within +-1%. It also serves as a prototype for an ISA injection magnet, and is to be operated in UHV in the 10^{-11} Torr range. Special measures to achieve this goal are also discussed.

17266 (BNL—29208) Status of the National Synchrotron Light Source control system. Bozoki, E.; Culwick, B.B.; Smith, J.D. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—81). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The control system for the National Synchrotron Light Source is implemented using dual central computers and many remote microprocessors. This paper describes developments in four areas: (1) system organization; (2) hardware status, particularly control desk and operator support facilities; (3) central computer software system organization to support data base structures and access, and communication between application programs and hardware; and (4) high level control programs which allow the operator to examine and control the transport lines and rings in terms of beam and machine parameters using mathematical models of the system. The output of these programs can be viewed on a color graphical display.

17267 (BNL—29210) Rf power systems for the national synchrotron light source. Dickinson, T.; Rheaume, R.H. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 2p. (CONF-810314—76). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The booster synchrotron and the two storage rings at the NSLS are provided with rf power systems of 3 kW, 50 kW, and 500 kW nominal output power, all at 53 MHz. This power is supplied by grounded grid tetrode amplifiers designed for television broadcast service. These amplifiers and associated power supplies, control and interlock systems, rf controls, and computer interface are described.

17268 **(BNL—29213) Higher-order terms in a perturbation expansion for the impedance of a corrugated wave guide.** Krinsky, S.; Gluckstern, R.L. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—72). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A circular waveguide is considered whose radius $a(z) = a(1+\epsilon\, s(z))$ varies periodically with the axial coordinate z. Chatard-Moulin and Papiernik have introduced a perturbation expansion in powers of ϵ for the longitudinal impedance of such a waveguide. The derivation of this expansion is reformulated in a manner which elucidates the structure of the higher-order terms, and allows the determination of the dependence on ϵ of the resonant frequencies. For a square-wave (SW) wall distortion, there are divergent coefficients in the perturbation expansion. Hence, a special treatment is required in this case, and a calculation of the resonant behavior is presented for small ϵ, using an approach which does not assume an expansion in powers of ϵ. The resulting expression for the resonant impedance involves functions singular at $\epsilon = 0$; however, to leading order in ϵ, the loss-factors and resonant frequencies are in agreement with perturbation theory.

17269 **(BNL—29226) R.F. cavity design for the NSLS.** Batchelor, K.; Galayda, J.; Hawrylak, R. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—70). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The r.f cavity design for the Booster, vuv ring and x-ray ring of the NSLS is described together with the mechanical design of tuners, coupling and monitoring loops and the temperature control systems. The results of higher order mode measurements as compared with Superfish calculations are also presented.

17270 **(BNL—29242) Status of the National Synchrotron Light Source project.** Heese, R.N. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 2p. (CONF-810314—74). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The National Synchrotron Light Source is in its final stages of construction, and as the turn-on time for the 700 MeV vuv storage ring draws near, an overview of the project is presented. Emphasis is placed on the linac and booster synchrotron performance and the status of major subsystems.

17271 **(BNL—29305) MEQALAC development at Brookhaven.** Gammel, G.; Brodowski, J.; Keane, J.; Maschke, A.; Meier, E.; Mobley, R.; Sanders, R. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—99). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A novel method of transporting and accelerating high brightness ion beams, called MEQALAC, has been developed at Brookhaven. The concept and its motivation will be described first, with reference to other sources for detail, and then the performance of two operating MEQALAC's will be presented.

17272 **(CONF-810314—82) Coupled operation of the Oak Ridge isochronous cyclotron and the 25 MV tandem.** Lord, R.S.; Ball, J.B.; Beckers, R.M.; Cleary, T.P.; Hudson, E.D.; Ludemann, C.A.; Martin, J.A.; Milner, W.T.; Mosko, S.W.; Ziegler, N.F. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Coupled operation of the 25 MV tandem and the Oak Ridge Isochronous Cyclotron (ORIC) was achieved on January 27, 1981. A beam of 38 MeV $^{16}O^{2+}$ was injected into ORIC, stripped to 8^+ and accelerated to 324 MeV. Shortly afterwards, the energy was increased to the maximum design value of 25 MeV/amu (400 MeV). A spectrum taken of the scattering of this beam from a thin ^{208}Pb target in the broad range spectrograh exhibited a resolution of 115 keV (FWHM). Performance of the system was in close agreement with that predicted from calculations.

17273 (DOE/NDC—21/L(Vol.1), pp 7-18) **Intense high energy neutron sources and their characteristics.** Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The use of high-energy neutrons has continued to increase. Progress on the recommendations of the 1977 Symposium is summarized. The present status of neutron sources, their characteristics and uses are reviewed at some length. Fourteen recommendations are made. (RWR)

17274 (DOE/NDC—21/L(Vol.1), pp 75-98) **Review of source characterization for fusion materials irradiations.** Greenwood, L.R. (Argonne National Lab., IL). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Fusion materials irradiations require accurate knowledge of neutron fluence, spectrum, and derived damage parameters, such as nuclear displacements, transmutations, and gas production. Irradiations are being conducted in diverse facilities including mixed-spectrum and fast reactors, T(d,n) and Be(d,n) accelerator sources, and high-energy spallation neutron sources. The characterization of each type of source is discussed, with emphasis on the principal sources of error and needed improvements in dosimetry techniques and nuclear data needs. 6 figures, 6 tables.

17275 (DOE/NDC—21/L(Vol.2), pp 629-637) **Source imaging for FMIT using a neutron pin-hole camera.** Johnson, R.G.; Behrens, J.W.; Bowman, C.D. (National Bureau of Standards, Washington, DC). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

A pin-hole camera technique has been used to measure the variation in neutron emission intensity over the area of the neutron-producing target of the NBS Electron Linac. The method uses a linear position-sensitive proportional counter (PSPC) with an intrinsic spatial resolution of 1.0 mm. The pin hole is made in a thick sheet of cadmium, and neutron energy (<0.3 eV) selection is achieved by time-of-flight. Both one-dimensional and two-dimensional detectors are now available for this work. In a completely separate experiment the neutron cone obtained from the (d,t) reaction using the associated-particle technique was imaged by a two-dimensional PSPC. This second measurement demonstrated the use of the two-dimensional detector for imaging high-energy (14-MeV) neutrons. 4 figures.

17276 **(LA-tr—80-42) Phase and bunch shape measurement in the UNILAC with capacitive probes.** Glatz, J.; Keller, H.J.; Strehl, P. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Translation of GSI 73-1, Feb 1973. 20p. NTIS, PC A02/MF A01.

A procedure for monitoring the phase position of the centers of the particle packages relative to the RF phase using capacitive probes is studied. (GHT)

17277 **(LA-UR—81-731) LAMPF hardware beam transmission monitor systems.** Browman, A. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—86). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The average power in the LAMPF primary beam is now approximately 450 kW. At these power levels errant beams can quickly destroy accelerator or experimental area beam line components, while the long-term deposition of even a small fraction ($<<1\%$) of the beam energy in unintended locations can result in activation levels too high for hands-on maintenance. This paper describes the

present status of the hardware beam transmission monitor, which is one of several evolving redundant protection systems. Beam currents are measured by toroids located at various places along the accelerator and in the experimental areas. Losses are determined by subtracting the signals from appropriate toroids. Long-term (~ month) stabilities are sufficient to enable loss tolerances of +-0.5 μA to be maintained with 500-μA average currents, while short-term (~ hour) fluctuations are an order of magnitude smaller. The absolute accuracy of the beam measurements is believed to be +-0.5%. These systems have provided reliable protection with little maintenance required for the past few years.

17278 **(LA-UR—81-746) Prospects for pion and kaon factories.** Nagle, D.E. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 3p. (CONF-810314—89). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

In general, the pion factories have lived up to the expectations for them with respect to their performance as accelerators and their output of interesting results on the physics of particles and of the nucleus. Interest in kaon factories, seen as an extension of the pion factories, is presently very high, both as to accelerator design and as to facility and experimental program planning.

17279 **(LA-UR—81-772) Status of the Los Alamos gyrocon.** Tallerico, P.J. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—85). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The gyrocon is a deflection-modulated RF amplifier that can achieve very high peak- and average-output power, as well as excellent direct-current-to- radio-frequency conversion efficiency. The electron dynamics of the gyrocon are analyzed with a large-signal computer code that is used to design a prototype gyrocon. This gyrocon is now built and it has been operated at low duty cycle. The design goals, construction details, and initial operating results of the prototype gyrocon are discussed.

17280 **(LA-UR—81-783) Intense low-emittance-electron-gun development at PHERMEX.** Elliott, J.C.; Faehl, R.J.; Fullbright, H.J.; Moir, D.C.; Swannack, C.E. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 15p. (CONF-810314—107). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Experimental measurements and theoretical calculations have been performed and compared for the PHERMEX standard electron gun. Slight changes in the gun configuration have produced significant changes in beam intensity and quality. It is hoped that the present gun configuration can be extended to even higher perveances (without significant loss of beam quality) through a joint theoretical and experimental effort.

17281 **(LA-UR—81-805) Beam characteristics in the LAMPF biomedical channel.** Paciotti, M.; Bradbury, J.; Inoue, H.; Rivera, O.; Sandford, S. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—103). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Techniques to determine the muon component in the pion therapy beams at the Clinton P. Anderson Meson Physics Facility biomedical channel are reported. The objective is to provide input to the project's treatment planning code PIPLAN which uses measured beam data to generate dose distributions. In these data it is important to identify the particles emanating from the channel by type, i.e., pion, muon, or electron. Muons from decays in the latter portion of the channel form a large halo around the pion beam. As our pion field sizes have increased, this halo has become an increasingly larger fraction of the beam. Results from beam measurements and computer simulations are presented.

17282 **(UCRL—85037) Advanced Test Accelerator (ATA) pulse power technology development.** Reginato, L.L.; Branum, D.; Cook, E. (Lawrence Livermore National Lab., CA (USA)). 9 Mar 1981. Contract W-7405-ENG-48. 5p. (CONF-810314—100). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The Advanced Test Accelerator (ATA) is a pulsed linear induction accelerator with the following design parameters: 50 MeV, 10 kA, 70 ns, and 1 kHz in a ten-pulse burst. Acceleration is accomplished by means of 190 ferrite-loaded cells, each capable of maintaining a 250 kV voltage pulse for 70 ns across a 1-inch gap. The unique characteristic of this machine is its 1 kHz burst mode capability at very high currents. This paper dscribes the pulse power development program which used the Experimental Test Accelerator (ETA) technology as a starting base. Considerable changes have been made both electrically and mechanically in the pulse power components with special consideration being given to the design to achieve higher reliability. A prototype module which incorporates all the pulse power components has been built and tested for millions of shots. Prototype components and test results are described.

17283 **(UCRL—85060) Design and performance of the 1.5 MV injector for FXR.** Kulke, B.; Ravenscroft, D.S.; Vogtlin, G.E. (Lawrence Livermore National Lab., CA (USA)). 4 Mar 1981. Contract W-7405-ENG-48. 5p. (CONF-810314—84). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The new flash x-ray machine (FXR) at LLNL is scheduled for completion in late 1981. This is a 54 module, linear induction accelerator, designed to deliver 500 Roentgen at 1 m as bremsstrahlung from a 20 MeV, 4 kA, 60 ns pulsed electron beam. The 1.5 MV, cold cathode injector makes use of six accelerator modules as voltage sources. High voltage testing of the accelerator modules and their associated pulse forming lines and Marx banks has been completed, and beam tests of the complete injector assembly are in progress. Design information and preliminary test results are presented.

17284 **(LA-tr—80-43) Phase probe measuring system in the UNILAC: probe dimensioning and signal evaluation.** Strehl, P.; Klabunde, J.; Schaa, V.; Vilhjalmsson, H.; Wilms, D. (Los Alamos Scientific Lab., NM (USA)). Dec 1980. Translation of GSI 79-13, Dec 1979. 74p. NTIS, PC A04/MF A01.

Correct adjustment of the UNILAC accelerating structures requires precise knowledge of the intensity distribution of the beam in a longitudinal phase space. Electromagnetic measurement procedures can fill this role when the applied probes and the accessory signal preparation system is optimized with respect to the parameters to be observed. Several criteria in optimizing the probe are considered for UNILAC. Based on theoretical and experimental studies for the selected probe and signal preparation systems, some results are discussed. Finally, the usefulness of the measurement system for observations in the longitudinal phase space are demonstrated using practical experience from routine operation. (GHT)

4304 Storage Rings

REFER ALSO TO CITATION(S) 17259, 17266, 17267, 17270, 17632

17285 **(BNL—29091) ISABELLE cavity gap assemblies.** Plotkin, M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—95). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

In a storage ring, where beam lifetime is measured in hours, it is necessary to keep the longitudinal impedance, as seen by the beam, very low, even into the gigahertz region. This is necessary to prevent the excitation of longitudinal instabilities. These impedances are due to the resistive wall effect and any deviation from a smooth vacuum chamber such as at pick-up electrodes, vacuum pump stations, rf cavities, etc. At low frequencies, up to 10 to 20 MHz, the

low impedance requirement for the cavities can be satisfied by designing the driving power amplifiers with a very low output impedance. For ISABELLE a method has been designed for building a network into the cavity accelerating gaps which will satisfy the impedance criteria to at least 1300 MHz. The maximum allowable impedance at any frequency, f, is given in the form Z/n where n = f/f/sub rotation/. For the ISABELLE accelerating cavity, operating at 235.5 KHz, Z/n must be less than 10 ohms. For the stacking cavity, operating at 4.45 MHz, Z/n < 1 ohm.

17286 **(BNL—29188) ISABELLE magnet power supply system performance analysis.** Edwards, R.J. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—98). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The power supply system that will energize the superconducting magnets in the ISABELLE 400 x 400 GeV accelerator must supply various voltages and currents. The voltages for the correction winding range from ten to one hundred twenty-five volts unipolar and bipolar with current rating of 50 to 300 amperes. The main field winding requires voltages from 90V (at flattop) to 600V during maximum ramp rate or acceleration cycle. The power supplies are programmable over their full range of output current with a reproducibility error varying from +- 10 ppM to +- 400 ppM of full scale. Included within the reproducibility error are the long and short term stability requirements of the power supplies. The purpose of this paper is to define some of the design goals and outline the approach taken in reaching these goals.

17287 **(BNL—29194) Study of factors which affect training in ISABELLE R and D magnets.** Wanderer, P.; Bleser, E.; Cottingham, G. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—91). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Five R and D dipole magnets have been assembled with different levels of tangential prestress applied to the windings. Four magnets have trained beyond the ISABELLE 5T operating field. Three have trained to the short sample limit of the superconducting braid. The two magnets with the highest level of tangential prestress required the fewest training quenches to reach 5T. The training history of these R and D magnets is better than that of the eleven industrial magnets. Two of the industrial magnets were trained beyond 4.5T; the others reached fields in the range 3.8T to 4.2T. The industrial magnets had generally lower levels of prestress than the R and D magnets and differed in other important respects as well. These changes were designed to reduce the heat generated by conductor motion due to Lorentz forces. Construction of magnets with the present design has eliminated the largest part of the training quenches seen in the industrial series of magnets.

17288 **(BNL—29195) Magnetic properties of ISABELLE superconducting quadrupoles.** Willen, E.; Engelmann, R.; Greene, A.F.; Herrera, J.; Jaeger, K.; Kirk, H.; Robins, K. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—93). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A number of superconducting quadrupole magnets have been constructed in the ISABELLE project during the past year. With these quadrupoles, it was intended to test construction techniques, magnet performance and measuring capability in an effort to arrive at a quadrupole design satisfactory for use in the storage ring accelerator. While these magnets are designed to have dimensions and field properties close to those needed for regular cell ISABELLE quadrupoles, no effort was made to make them identical to one another. This report details the performance characteristics of one of these magnets, MQ3005.

17289 **(BNL—29196) Beam - and drive - controlled amplifier for the ISABELLE accelerating system.** Luccio, A.; Puglisi, M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 2p. (CONF-810314—64). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The need of very low output impedance rf systems for heavy particle accelerators has led to the development of very sophisticated amplifier configurations. Among them, the use of a common-anode final amplifier seems most promising. If the output impedance is defined in the Thevenin Theorem sense, then class-A operation seems unavoidable. However, for particle dynamics only the voltage induced by the beam is of real concern and voltage requirements do not necessarily demand a time invariant output impedance. These considerations led to investigation of the conditions that must be met to obtain control over the beam-induced voltage. It was possible to demonstrate that in the common anode case the induced voltage can be largely independent of the bias applied to the final tube, if the beam loading is very strong.

17290 **(BNL—29197) ISABELLE superconducting power distribution system.** Woodle, M.H. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—94). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

Research during the period June 1980 through May 1981 is described. Areas studied include: radioactive decay of ^{199}Po and ^{201}Po, ^{202}At, ^{189}Tl energy levels from Pb decay, ^{192}Pb → ^{192}Tl → ^{192}Hg, and Ba decays; high spin states; inelastic scattering and reactions of heavy ions from deformed nuclei; and nuclear structure theory. (GHT)

17291 **(BNL—29209) Free electron laser experiment at the NSLS 700 MeV electron storage ring.** Blewitt, J.P.; Blumberg, L.; Campillo, A.J. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—68). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

A free electron laser experiment is described, to be performed with the 700 MeV electron storage ring of the National Synchrotron Light Source. The experiment is designed to study the parameters of the FEL in an electron storage ring and the performance of this laser as a source of short wavelength radiation in the vuv region of the spectrum. The initial experiment will be carried out at a wave length of approximately 3000 A, utilizing a permanent magnet undulator. For an average electron current of 1A distributed in three beam bunches, the small signal gain per pass (relative enhancement of the radiation intensity per electron bunch pass through the undulator) is calculated to be approximately 10%.

17292 **(BNL—29217) Outgassing rate of the copper-plated beam tube for ISABELLE.** Hseuh, H.C.; Gaudet, E.F. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—96). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The ultrahigh vacuum system of the intersecting storage accelerator, ISABELLE, will consist of two interlaced rings of stainless steel beam tubes with a circumference 2-1/2 miles each. To obtain a good heat conduction during bakeout and to reduce the resistive wall instability during beam operation, a lmm thick copper coating will be electroplated to the outer surface of this 1.5 mm thick beam tube. To minimize the beam loss due to beam-gas collision, the pressure inside the beam tube is required to be 1 x 10^{-11} Torr (N_2 equivalent) or less. To achieve this ultrahigh vacuum, the outgassing rate of the 304 LN stainless steel tubes has been reduced to ~ 1 x 10^{-13} Torr. l/cm^2. sec by vacuum firing at 950°C for one hour. However, during acid-bath electroplating of copper, significant amount of hydrogen will be reintroduced and trapped in stainless steel which will substantially increase the outgassing rate (to ~ 2 x 10^{-12} Torr . l/cm^2 sec). The outgassing characteristics of these copper-plated beam tubes are studied and discussed within the scope of diffusion and energy of activation. Methods to reduce the

outgassing rate to an acceptable level (~ 1 x 10^{-13} Torr . l/cm^2 . sec) are also given.

17293 **(BNL—29218) Design of fast kickers for the ISABELLE beam abort system.** Nawrocky, R.J.; Montemurro, P.A.; Baron, J. (Brookhaven National Lab., Upton, NY (USA)). 1981. AC02-76CH00016. 3p. (CONF-810314—90). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The ISA beam abort (extraction) system must be highly efficient, in the sense of producing minimum beam loss, and reliable to prevent serious damage to accelerator components by the circulating high-energy beams. Since the stored beams will be debunched, the low-loss requirement can be met only with ultra-thin extraction septa and/or fast-acting kickers. This paper examines the design of the ISA extraction kickers subject to a set of extraction channel constraints and a given maximum working voltage. Expressions are derived for determining system parameters for both a lumped parameter magnet and a delay-line magnet. Using these relationships, design parameters are worked out for several possible system configurations. The paper also describes the construction of a full-scale prototype module of the kicker and summarizes the preliminary test results obtained with the module.

17294 **(BNL—29232) First cell magnet system tests.** Schneider, W.J.; Brown, D.P.; Briggs, J.J.; Foerster, C.L.; Halama, H.J.; Schlafke, A.P.; Werner, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—66). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The ISABELLE refrigeration system utilizes compressed liquid helium to supply refrigeration to nearly 1100 superconducting bending and focusing magnets. These magnets steer the proton orbits of the accelerator and are arranged into two interlocking rings. The total heat load that the refrigerator must provide is made up of the heat load of the magnets, magnet leads and vessels and the interconnecting piping to the refrigerator. The design and test results of the magnet system during various operating conditions in use on the ISABELLE prototype, the First Cell, are described.

17295 **(BNL—29236) Mechanical properties of ISABELLE superconducting coils.** Thompson, P.; Bertsche, A.; Fuhrmann, J.; Greene, A.; Grove, E.; Repeta, L.; Short, F.; Tannenbaum, M.; Wanderer, P. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—97). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

As a part of the manufacturing processes, several mechanical measurements are made on ISABELLE dipoles. These are done both to control the process and to provide information for the evaluation of the behavior of the completed magnets. This paper discusses the Young's Modulus (E = 1-3 x 10^6 psi), the thermal contraction of the coil assembly ($\Delta L/L$ = 290 +- 17 x 10^{-5} at 77°K), and the loss of applied prestress with time (~ 20% for times 20 days).

17296 **(BNL—29241) Pulsed rf operation analysis.** Puglisi, M.; Cornacchia, M. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 4p. (CONF-810314—65). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The need for a very low final amplifier output impedance, always associated with class A operation, requires a very large power waste in the final tube. The recently suggested pulsed rf operation, while saving a large amount of power, increases the inherent final amplifier non linearity. A method is presented for avoiding the large signal non linear analysis and it is shown how each component of the beam induced voltage depends upon all the beam harmonics via some coupling coefficients which are evaluated.

17297 **(BNL—29307) Upgraded coil configuration for ISABELLE magnets.** Hahn, H.; Dahl, P.F.; Kaugerts, J.E.; Prodell, A.G. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 4p. (CONF-810340—3). NTIS, PC A02/MF A01.

From 7. international conference on magnet technology; Karlsrube, F.R. Germany (30 Mar 1981).

Achievement of the design field of 5 T in the ISABELLE dipole magnets is turning out to be more arduous than expected and several avenues of improvement are being pursued. One possibility for improving training and peak field performance is discussed in this paper. It has been recognized that the inert spacers with their adjacent active turns in the cosine magnet windings can be replaced by a double thickness braid operating at approximately half-current density in 46 of the 190 turns. Since the high-field region occurs in the low current density turns near the poles, a performance improvement can be expected. It has been verified that the proposed coil configuration satisfies the field requirements and details thereof are given. Results from an experimental magnet in which superconducting spacer turns are used to simulate half-current density windings are presented. Construction of thick braid coils is being planned and the status of these magnets is reviewed.

17298 **(DOE/ER/10740—1) Synchrotron topographic project. Progress report, September 1, 1980-February 20, 1981.** Liu, J.M.; Bilello, J.C. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering). 1981. Contract AC02-80ER10740. 30p. NTIS, PC A03/MF A01.

A summary of the progress is given for the Synchrotron Topographic Project at the Department of Materials Science, SUNY Stony Brook. The tasks of the design, construction, and testing of an x-ray topography beam line undertaken jointly by the Principal Investigators, the members of the Participating Research Team, and the National Synchrotron Light Source, are briefly reviewed. Efforts in laboratories at Stony Brook in areas pertinent to the future operation of the white-beam topography beam line are reviewed. It is concluded that the overall progress is in step with the construction schedule of x-ray beam lines at NSLS.

17299 **(LA-UR—81-781) Novel current monitor for DC and modulated magnets in the proton storage ring.** Sandberg, B.R. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810314—106). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

An analytical description is given of the zero flux dc current transformer. (GHT)

17300 (SLAC—239, pp 309-327) **CERN LEP project.** Potter, K.M. (CERN, Geneva, Switzerland). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

A Large Electron Positron project has been discussed by the European High Energy physics community in general and at CERN in particular since 1976. The European Committee for Future Accelerators (ECFA) has organized a number of studies on the physics program which could be carried out with an electron-positron collider with beam energy around 100 GeV and, in parallel, feasibility and design studies have been carried out at CERN with the collaboration of a number of other European Laboratories. The LEP project has now reached a rather advanced stage and was officially presented to the CERN member states at their June meeting of this year. This report outlines the reasons why the European High Energy Physics community has chosen to construct LEP, the general features of the machine with emphasis on the latest developments, a brief review of the experimentation which has been discussed in the various studies and finally the status and timescale of the project as of July 1980.

17301 (SLAC—239, pp 329-341) **High energy e^+e^- collider at Cornell using superconducting RF cavities.** Mistry, N.B. (Cornell Univ., Ithaca, NY). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

A design study is under way at Cornell for an e^+e^- colliding ring of sufficient energy to observe and study the Z^0 - the neutral intermediate boson - and with sufficient luminosity to study in detail the weak interaction as well as rare decay modes of the various heavy particles produced at the Z^0. This design study has not yet reached the status of a formal proposal for funds. The design depends crucially on the successful development of superconducting RF cavities. For the present, major effort is put into the design and development of prototype superconducting RF cavities capable of being used in a high energy electron storage-ring.

17302 (SLAC—239, pp 343-347) **PEP.** Paterson, J.M. Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The design and construction of the PEP project is briefly reviewed. The initial testing of the storage ring system and its present performance is described. The short-range plans for continuing development are discussed.

17303 (SLAC—239, pp 361-380) **Results from CESR.** Moneti, G. (Syracuse Univ., NY). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The review covers the following topics: a few data on the performance of the storage ring itself, CESR; a brief description of the CLEO and CUSB detectors; a summary of the detection and properties of the Y and the first two excited states Y′ and Y″; the discovery and characteristics of the third excited state the Y‴, or 4S state, the first one above threshold for decay into bottom mesons; and a few very preliminary properties of the B mesons themselves.

17304 (SLAC—239, pp 381-424) **Highlights from PETRA experiments.** Wolf, G. (DESY, Hamburg, Germany). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The experiments at the DESY e^+e^- storage ring PETRA presently are focussed on four major subjects: tests of quantum electrodynamics (QED) and search for weak neutral current effects; search for new particles such as heavy leptons and new heavy quark states; analysis of gluon bremsstrahlung in the hadron annihilation channel; and two photon interactions. This lecture concentrates on some of the topics.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 16537, 17303, 17403, 17642, 17703, 17745

17305 **(PNL—3536) Hanford Personnel Dosimeter supporting studies FY-1980.** Endres, G.W.R.; Cummings, F.M.; Aldrich, J.M.; Thorson, M.R.; Kathren, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1981. Contract AC06-76RL01830. 296p. NTIS, PC A13/MF A01.

Separate abstracts were prepared for the 10 sections of this report which describe fundamental characteristics of the Hanford multipurpose personnel dosimeter (HMPD). Abstracts were not prepared for Appendix A and Appendix B which deal with calculated standard deviations for 100 mrem mixed field exposures and detailed calculations of standard deviations, respectively. (KRM)

17306 (PNL—3536, pp 1.1-1.5) **Introduction.** Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

Studies included in this document illustrate the importance of designing and calibrating the personnel dosimeter based on field conditions. The current personnel dosimeter and calibration techniques were developed to be especially sensitive to the low energy photon and thermal neutron irradiation received during plutonium separation. Calibration sources used since the inception of the albedo thermoluminescent dosimeter for each radiation type are: Non-penetrating - several aged uranium disk sources are used each equipped with a specially designed exposure jig; Penetrating - for the past few years, a cesium-137 source has usually been used although a cobalt-60 has been used occasionally; Slow Neutron - a graphite moderated sigma pile is used; Fast Neutron - a PuF_4 source is used.

17307 (PNL—3536, pp 2.1-2.6) **Dosimeter design specifications.** Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

The combination dosimeter and security credential holder was developed as part of the effort involved to provide an automated readout and thermoluminescent dosimetry capability at Hanford. The holder is designed to accomodate the thermoluminescent dosimeter card, appropriate filters, the security credential and a snap type clip. The body of the holder is ABS plastic (acrylontrile-butadiene-styrene). The dosimeter holder and card is mold casted providing uniformity of construction.

17308 (PNL—3536, pp 3.1-3.13) **Neutron response study.** Endres, G.W.R.; Fix, J.J.; Thorson, M.R.; Nichols, L.L. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

Neutron response of the albedo type dosimeter is strongly dependent on the energy of the incident neutrons as well as the moderating material on the backside of the dosimeter. This study characterizes the response of the Hanford dosimeter for a variety of neutron energies for both a water and Rando phantom (a simulated human body consisting of an actual human skeleton with plastic for body muscles and certain organs). The Hanford dosimeter response to neutrons of different energies is typical of albedo type dosimeters. An approximate two orders of magnitude difference in response is observed between neutron energies of 100 keV and 10 MeV. Methods were described to compensate for the difference in dosimeter response between a laboratory neutron spectrum and the different spectra encountered at various facilities in the field. Generally, substantial field support is necessary for accurate neutron dosimetry.

17309 (PNL—3536, pp 4.1-4.12) **High energy photon response.** Cummings, F.M.; Yoder, R.C.; Endres, G.W.R.; Kathren, R.L. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

This study examines the response of the Hanford 4-chip and 5-chip dosimeter to high energy photons. The dose response of the Hanford Multipurpose Personnel Diometer (HMPD) to photons with energies greater than 0.65 MeV has been evaluated relative to the dose produced by photons from a ^{60}Co source. The penetrating dose determined with the HMPD is compared to the 1 cm depth dose in tissue measured with an extrapolation chamber. The results of the study indicate that the HMPD can be used to estimate the 1 cm depth dose in tissue from photons with energies between 0.65 MeV and 3.0 MeV to within an accuracy of 15%. However, the 1 cm depth dose is underestimated by 38% when the dosimeter is irradiated in a beam of very high energy photons produced by bombarding a tungsten target with 25 MeV electrons.

17310 (PNL—3536, pp 5.1-5.33) **Beta and low energy photon response.** Cummings, F.M.; Yoder, R.C. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

This study quantifies the observed dosimeter response for a variety of beta and photon energies. The reportable skin dose is also included in the discussion. Presently, the reportable skin dose is determined by adding the nonpenetrating and penetrating dose components together. The scheme presently used to estimate the nonpenetrating dose component for personnel at Hanford utilizes the difference in light outputs of a TLD-700 chip filtered only by the security credential (total of 88 mg/cm^2) and a TLD-700 chip filtered by a 0.064 cm thick aluminum filter as well as the credential. The study indicates that a maximum chip response occurs in the range of photon energies between 30 keV and 40 keV and results in an overestimation of the calculated nonpenetrating dose by a factor of approximately 2. The reportable skin dose is overestimated by a factor of approximately 2.5 following adding the non-

penetrating and penetrating dose components. The effect of removing the security credential is slight and tends to increase the steepness of slope in the photon response curve.

17311 (PNL—3536, pp 6.1-6.30) **Evaluate existing radiation fields.** Aldrich, J.M.; Haggard, D.L.; Endres, G.W.R.; Fix, J.J. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

Knowledge of the spectrum of energies for beta, gamma, and neutron radiation experienced in the field is crucial to the proper interpretation of personnel dose. Calibration sources and techniques are determined on the basis of their relationship to field exposure. Selected techniques were used to obtain neutron, photon, and beta energy spectra data at several Hanford locations. Four neutron energy spectra and dose measurement methods were used: (1) multisphere spectrometer system; (2) tissue equivalent proportional counter (TEPC); (3) RASCAL (9" to 3" sphere ratios); and (4) helium-3 neutron spectrometer. Gamma spectroscopy was done using standard techniques. A specially designed TLD dosimeter was used to obtain beta spectrum measurements. The design and use of each of these instruments is described in the body of this report. Data collected and analyzed for each of the Hanford locations are included.

17312 (PNL—3536, pp 7.1-7.26) **Phantom position dependence.** Thorson, M.R.; Endres, G.W.R. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

Sensitivity of the Hanford dosimeter response to its position relative to the phantom and the neutron source has always been recognized. A thorough investigation was performed to quantify dosimeter response according to: (a) dosimeter position on phantom, (b) dosimeter distance from phantom, and (c) angular relationship of dosimeter relative to neutron source and phantom. Results were obtained for neutron irradiation at several different energies.

17313 (PNL—3536, pp 8.1-8.14) **Environmental effects on the Hanford Multipurpose Personnel Dosimeter.** Cummings, F.M. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

This study examines the effects of environmental conditions on the response of TLD-700. Of particular interest is the effect of chemical contaminants, routinely encountered in the course of work, in enhancing or inhibiting the response of TLD's. The effects of contaminants on Teflon TFE tape are also studied. Additionally, the effects of microwave irradiation and mechanical shock are investigated as well as the use of glow analysis to identify spurious signals.

17314 (PNL—3536, pp 9.1-9.11) **Extremity dosimeter studies.** Kathren, R.L.; Aldrich, J.W.; Endres, G.W.R.; Winegardner, M.K. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

Finger rings employing a single TLD-700 chip have served as the routine extremity dosimeter for the past several years. The response characteristics of the finger ring are described in this study. Proper annealing is crucial to accurate and precise readout and dose assignation. The standard PNL annealing procedure of 400°C for one hour followed by 100°C for two hours appears best; reader annealing is unacceptable, showing extremely poor precision. Although the rings are in the main suitable from a human factors standpoint, adjustable size is suggested for future models. Also, it should be noted that the rings are not suitable for neutron dosimetry, but can be used for beta dosimetry with a suitable correction factor.

17315 (PNL—3536, pp 10.1-10.56) **Statistical and low dose response.** Thorson, M.R.; Endres, G.W.R. Feb 1981.

In Hanford Personnel Dosimeter supporting studies FY-1980.

The low dose response and the lower limit of detection of the Hanford dosimeter depend upon may factors, including the energy of the radiation, whether the exposure is to be a single radiation or mixed fields, annealing cycles, environmental factors, and how well various batches of TLD materials are matched in the system. A careful statistical study and sensitivity analysis were performed to determine how these factors influence the response of the dosimeter system. Estimates have been included in this study of the standard deviation of calculated dose for various mixed field exposures from 0 to 1000 mrem.

17316 (SLAC—239, pp 193-213) **Drift and proportional tracking chambers.** Jaros, J.A. (Stanford Univ., CA). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Many techniques have been exploited in constructing tracking chambers, particle detectors which measure the trajectories and momenta of charged particles. The particular features of high-energy interactions - charged particle multiplicities, angular correlations and complex vertex topologies, to name a few - and the experimental environment of the accelerator-event rates, background rates, and so on - accent the importance of certain detector characteristics. In high energy e^+e^-, (anti p)p and pp interactions the final states are dominated by closely collimated jets of high multiplicity, requiring good trackpair resolution in the tracking chamber. High energy particles deflect very little in limited magnetic field volumes, necessitating good spatial resolution for accurate momentum measurements. The colliding beam technique generally requires a device easily adapted to full solid-angle coverage, and the high event rates expected in some of these machines put a premium on good time resolution. Finally, the production and subsequent decays of the tau, charmed and beautiful mesons will provide multiple vertex topologies. To reconstruct these vertices reliably will require considerable improvements in spatial resolution and track-pair resolution. This lecture considers the proportional counter and its descendant, the drift chamber, as tracking chambers. Its goal is to review the physics of this device in order to understand its performance limitations and promises.

17317 (SLAC—239, pp 215-240) **Particle identification by energy loss measurement and long drift imaging chambers.** Marx, J.N. (Univ. of California, Berkeley). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Two experimental techniques which are the ingredients for a new generation of charged particle detectors are discussed. These techniques, particle identification by energy loss measurement and long drift imaging chambers are used separately, or in tandem to configure detector systems (e.g., ISIS, BEBC-EPI, CRIRIS, TPC and others) which can obtain high quality data over large solid angles. The basic idea of these detectors is to use as much as is possible of the information left as ionization by charged particles traversing a gaseous medium. This residual ionization trail contains trajectory information and, from the distribution of energy loss, velocity information. Since such information is to be collected over a large volume (large solid angle), ionization electrons are drifted in some of these detectors over large distances to sense elements where the information is extracted.

17318 (SLAC—239, pp 241-264) **Sampling calorimeters in high energy physics.** Gordon, H.A.; Smith, S.D. (Brookhaven National Lab., Upton, NY). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

At our current understanding of elementary particle physics, the fundamental constituents are the photon, quarks, gluons and leptons with a few highly forecasted heavy bosons. Calorimeters are essential for detecting all of these particles. Quarks and gluons fragment into many particles - at high energies, so many particles that one may not want to measure each one separately. This group of both charged and neutral particles can only be measured by calorimeters. The energy of an electron needs to be measured by a calorimeter and muon identification is enhanced by the recognition of a minimum ionizing particle passing through the calorimeter. Sampling calorimeters - those instruments in which part of the shower is sampled in an active medium sandwiched between absorbing layers - are reviewed. What follows is a very cursory overview of some fundamental aspects of sampling calorimeters. First, the properties of shower development are described for both the

electromagnetic and hadronic cases. Then, examples of various readout schemes are discussed. Finally, some currently promising new ideas in calorimetry are described. 21 references.

17319 (SLAC—239, pp 265-285) **Particle identification by Cerenkov and transition radiation.** Gilmore, R.S. (Stanford Univ., CA). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The Cerenkov counter has a role as a particle identifier for velocities which are too high for time-of-flight to be used, and too low for transition radiation detectors to give a useable signal. In beam lines the compensated differential counter is capble of giving the best resolution, but at high momenta the restriction on the spread of particle directions gives unacceptable limits on the beam acceptance. The transition radiation detectors being developed to identify hadrons at relatively low momentum do not have this restriction and might be used instead. For particles produced in an interaction, the ring imaging type of Cerenkov should give the best coverage for multiparticle events, but a threshold counter is much simpler, cheaper and faster where it can give adequate separation. Again at high values of γ the resolution of Cerenkov counters will fail and some form of transition radiation detector will be necessary.

17320 (SLAC—239, pp 287-308) **Time-of-flight measurements.** Atwood, W.B. (Stanford Univ., CA). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Time-of-flight measurments are used in high energy physics experiments to: (1) distinguish background from events and (2) identify particle types. Background reduction, and two techniques for making time-of-flight measurements, (1) conventional scintillation counters and (2) planar spark counters, are discussed. (GHT)

17321 **Method for measuring the density of lightweight materials.** Giacomelli, E.J.; Snow, S.G. (to Department of Energy). US Patent 4,228,351. 14 Oct 1980. Filed date 26 Feb 1979. vp.

PAT-APPL-015259.

This invention relates to a nondestructive method for measuring the density of articles composed of elements having a low atomic number such as plastic and carbon composites. The measurement is accomplished by striking the article with a collimated beam of X radiation, simultaneously monitoring the radiation scattered and the radiation transmitted by the article, then relating the ratio of the radiation scattered to the radiation transmitted with the density of the article. The above method is insensitive to all variables except density.

17322 **Method and an apparatus for non-invasively determining the quantity of an element in a body organ.** Vartsky, D.; Ellis, K.J.; Cohn, S.H. (to Dept. of Energy). US Patent Application 163,897. 27 Jun 1980. 19p.

An apparatus and a method for determining in a body organ the amount of an element with the aid of a gaseous gamma ray source, where the element and the source are paired in predetermined pairs, and with the aid of at least one detector selected from the group consisting of Ge(Li) and NaI(Tl). Gamma rays are directed towards the organ, thereby resonantly scattering the gamma rays from nuclei of the element in the organ; the intensity of the gamma rays is detected by the detector; and the amount of the element in the organ is then substantially proportional to the detected intensity of the gamma rays.

17323 **Cryogenic method for measuring nuclides and fission gases.** Perdue, P.T.; Haywood, F.F. (to Dept. of Energy). US Patent Application 145,643. 2 May 1980. 6p.

A cryogenic method is provided for determining airborne gases and particulates from which gamma rays are emitted. A special dewar counting vessel is filled with the contents of the sampling flask which is immersed in liquid nitrogen. A vertically placed sodium-iodide or germanium-lithium gamma-ray detector is used. The device and method are of particular use in measuring and identifying the radioactive noble gases including emissions from coal-fired power plants, as well as fission gases released or escaping from nuclear power plants.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 16389, 16428, 17355, 17407

17324 **Apparatus and method for downhole injection of radioactive tracer.** Potter, R.M.; Archuleta, J.; Fink, C.F. (to Dept. of Energy). US Patent Application 159-890. [nd]. 8p.

The disclosure relates to downhole injection of radioactive ^{82}Br and monitoring its progress through fractured structure to determine the nature thereof. An ampule containing granular ^{82}Br is remotely crushed and water is repeatedly flushed through it to cleanse the instrument as well as inject the ^{82}Br into surrounding fractured strata. A sensor in a remote horehole reads progress of the radioactive material through fractured structure.

17325 **(CONF-810437—1) Survey, applications, and prospects of Johnson noise thermometry.** Blalock, T.V.; Shepard, R.L. (Tennessee Univ., Knoxville (USA). Dept. of Electrical Engineering; Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

From 6. international symposium on noise in physical systems; Washington, DC, USA (6 Apr 1981).

Significant progress in the field of Johnson noise thermometry has occurred since the 1971 survey of Kamper. This paper will review the foundation work of Johnson noise thermometry, survey the basic methods which do not utilize quantum devices for noise thermometry for industrial temperatures, and present some applications of noise thermometry in temperature scale metrology and process temperature instrumentation. 35 references.

17326 **(DP-MS—80-105) Static ^{3}He/^{4}He gas mass spectrometer for low level tritium concentration measurements.** Halverson, J.E.; Herzog, L.F. II. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Nuclide Corp., State College, PA (USA)). 1981. Contract AC09-76SR00001. 12p. (CONF-810409—3). NTIS, PC A02/MF A01.

From IAEA international symposium on methods of low-level counting and spectrometry; Berlin, F.R. Germany (6 Apr 1981).

A dual collector static gas mass spectrometer designed specifically for measurement of helium-3 and helium-4 was constructed. This instrument will provide a very sensitive means of measuring tritium concentrations from environmental samples by determining the concentration of helium-3, the decay product of tritium. The tritium sample is collected in or converted to an aqueous form, degassed, and stored in a sealed container for at least two weeks to allow helium-3 to accumulate. The sensitivity is a function of the helium-3 accumulation wait time. For samples stored for one month, the predicted sample sensitivity based on the measured source sensitivity is 0.02 pCi/g (tritium in water) for a 3-gram sample.

17327 **(HEDL-SA—2122-FP) Microanalysis of light elements with an ultrathin window x-ray spectrometer.** Thomas, L.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract AC14-76FF02170. 5p. (CONF-800801—10). NTIS, PC A02/MF A01.

From Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference; San Francisco, CA, USA (4 Aug 1980).

The advantages of energy-dispersive x-ray (EDX) spectroscopy over electron loss spectrometry (ELS) are pointed out. Some examples utilizing carbon are shown. (MOW)

17328 **(LA-UR—81-679) High-precision multipass reflectometer.** Edwards, D.F.; Baumeister, P. (Los Alamos Scientific Lab., NM (USA); Optical Coating Lab., Inc., Santa Rosa, CA (USA)). 1981. Contract W-7405-ENG-36. 13p. (CONF-810429—1). NTIS, PC A02/MF A01.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

The multipass reflectometer has been shown to be a convenient and precise instrument for the measurement of spectral reflectances in excess of 0.99. This report gives a brief sketch of the ini-

tial setup of the reflectometer, its operation, optimization of parameters, and some limitations to the expected precision. The instrumental precision is set by the uncertainty in the computer fit of a straight line to the measured data. Systematic errors due to nonuniform photosurfaces and the effects of astigmatism have been minimized. We have used this reflectrometer to measure the absolute reflectance of evaporated aluminum films in the uv and visible regions. It has also been used to measure the low-level insertion losses of laser window materials for this same spectral region.

17329 (LBL—11650, pp 9.1-9.28) **Applied research in laser spectroscopy and analytical techniques.** Oct 1980.

In Energy and Environment Division annual report, 1979.

Areas of research summarized here are: applied physics and laser spectroscopy; operation of gas chromatograph/mass spectrometer for the identification of components in fossil energy and environmental samples; development and application of x-ray fluorescence analytical methods; the survey of instrumentation for environmental monitoring;extraterrestrial cause for the cretaceous tertiary extinction, experiment and theory; and precise analysis for better understanding of Guatemalan obsidian. (GHT)

17330 **Angle-resolved electron spectrometer with multidetection.** Hansson, G.V.; Goldberg, B.; Bachrach, R.Z. (Xerox Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, California 94304). *Review of Scientific Instruments, The ;* **52**: No. 4, 517-522(Apr 1981).

A high-resolution, angle-resolved photoemission electron spectrometer has been built which incorporates a position-sensitive multidetection system. The spectrometer is a 180 ° hemispherical electrostatic deflection analyzer utilizing preretardation, 1.5 ° angle-resolving optics mounted on a two-axis angular manipulator. Combined with the sample holder, independent control of the polar and azimuthal angles of both the sample and detector are available. The multidetection spectrometer collects through a PDP-11 based data acquisition and control system up to 32 resolution elements per spectral frame.

17331 **Microwave spectrometer for the detection of transient gaseous species.** Kolbe, W.F.; Zollner, W.; Leskovar, B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48. *Review of Scientific Instruments, The ;* **52**: No. 4, 523-532(Apr 1981).

A microwave spectrometer and associated apparatus for the detection of unstable free radical species is described. The spectrometer, which operates over a frequency range from 66—73 GHz, consists of a tunable Fabry—Perot resonator followed by superhetrodyne detection for high sensitivity at low power levels. The resonator tuning is accomplished by means of a computer-controlled stepping motor and by a piezoelectric tranducer which also permits the use of source modulation and phase sensitive detection at 100 Hz. The sensitivity of the spectrometer is adequate to permit the detection of rotational transitions with absorption coefficients as small as 2 x 10^{-9} cm^{-1}. The operation of the spectrometer is demonstrated by the detection of the two free radical species OH and SO. In the case of OH, a number of Λ-doubling transitions, previously unobserved, are reported.

17332 **Particle—velocity gauge system for nanosecond sampling rate of shock and detonation waves.** Hayes, B. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). W-7405-ENG-48. *Review of Scientific Instruments, The ;* **52**: No. 4, 594-603(Apr 1981).

A high-resolution, particle-velocity gauge system was developed to obtain a hydrodynamic streamline in the flow field associated with shock waves or detonation products. The system is composed of a passive current loop (stirrup probe) embedded in the host material, a magnetic field generator to establish a Lorentz force, and a computer-controlled, analog-to-digital transient recorder to monitor the gauge response. The operation principle is that the motion of one side of a rectangular loop in a magnetic field produces a current proportional to the velocity of that leg. System tests were conducted with 50-mm diam. by 50-mm long cylinders of 1,3,5-triamino—2,4,6-trinitrobenzene (TATB) explosive and explosive-driven polytetrafluoroethylene (PTFE). The velocity profiles obtained have a time resolution of a few nanoseconds with an amplitude uncertainty of approximately 2% based on a system error analysis. Detailed descriptions of the gauge system components are included.

17333 **Diagnostic system of the Lawrence Livermore National Laboratory two-stage light-gas gun.** Mitchell, A.C.; Nellis, W.J. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). W-7405-ENG-48. *Review of Scientific Instruments, The ;* **52**: No. 3, 347-359(Mar 1981).

A two-stage light-gas gun is used for a variety of dynamic physical-property measurements at 100 GPa (1 Mbar) pressures. The diagnostic system described here consists of a flash x-ray system to measure impactor velocity, detectors and electronics to measure shock-wave velocities with subnanosecond resolution, and data—analysis techniques that permit us to measure the tilt and distortion of the impactor and of the resulting shock front. We describe our methods for safely purging hydrogen gas from the system after each shot.

17334 **Simple, fast recovery, low-noise receiver amplifier for pulsed NMR experiments.** Stoll, M.E. (Sandia National Laboratories, Livermore, California 94550). *Review of Scientific Instruments, The ;* **52**: No. 3, 391-394(Mar 1981).

A fast recovery, low-noise receiver designed for use in pulsed NMR, especially high-resolution multiple-pulse NMR, is described. This receiver is easy to build from commercially available parts. Passive (but biased) voltage limiters placed before each amplifier in the cascade prevent any of the amplifiers from saturating, so it is only the limiters that ever saturate. Recovery times of 850 ns and 2.35 μs are measured with a 50-Ω load and a high Q (Q=141) resonant sample probe in the circuit, respectively. The receiver has a measured overall noise figure of 6.5 dB, including crossed diodes and filter on the input. An example of the use of the receiver to measure a short proton free-induction decay at 186.5 MHz is also shown.

17335 **Deep-level transient spectroscopy system using a spectrum analyzer.** Wang, C.D.; Lin, H.C. (Electrical Engineering Department, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics ;* **52**: No. 2, 546-549(Feb 1981).

In order to measure the thermal emission rate of a trap in semiconductor material without scanning the temperature, a new method, which utilizes a spectrum analyzer, has been developed. The theory on which our measuements depend is based on the relation between the time constant of a pure exponential wave and the relative amplitudes of its Fourier Components. The time constant is given by tau/sub s/=(tau/2π)[(10/sup c/-1)/(m²-10/sup c/n²)]/sup 1/2/, where c=(X-italic/sub n/-x/sub m//10, tau is the period of the exponential wave, and x/sub n/ and x/sub m/ are the amplitudes of the nth and mth harmonics in dB, respectively.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

17336 **(MHSMP—81-08) Study of PETN/LX-13 from semi-continuous recrystallized Mil. Spec. PETN.** Osborn, A.G.; Stallings, T.L.; Duncan, A.A.; Adams, J.C. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Feb 1981. Contract AC04-76DP00487. 6p. NTIS, PC A02/MF A01.

LX-13 made from semi-continuous recrystallized Mil. Spec. PETN consistently met or exceeded the extrudability requirements. The detonation velocities of three lots ranged from 7161 to 7276 m/s.

17337 **(MHSMP—81-09) Flyer sensitivity test.** Rhoton, N.O. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Jan 1981. Contract AC04-76DP00487. 20p. NTIS, PC A02/MF A01.

This is an interim report on the development of a flyer sensitivity test to be used for characterization of a variety of explosives having a relatively wide range of sensitivities. Included are descrip-

tions of the flyer device design and electrical firing source; preliminary results from HNS I and HNS II threshold tests; flyer planarity data under various conditions of bridge confinement; and velocity calibration data by VISAR measurements.

17338 **(MHSMP—81-10) High Z (ash) analysis of TATB.** Worley, R.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Feb 1981. Contract AC04-76DP00487. 9p. NTIS, PC A02/MF A01.

The ash content of TATB powder is determined using an x-ray spectrometer. Elemental identification of the ash is also determined. The instrument has been calibrated for the range of ash content < 0.10%.

17339 **(MLM—2811) Thermal analysis investigations of B/$CaCrO_4$.** Love, C.M.; Fread, C.L. Jr. (Mound Facility, Miamisburg, OH (USA)). 31 Mar 1981. Contract AC04-76DP00053. 15p. NTIS, PC A02/MF A01.

Thermoanalytical investigations were conducted on 22 blends of B/$CaCrO_4$ in a 20/80 weight ratio. A correlation was found between exothermic differential thermal analysis (DTA) peak shapes and ignition performance of the different blends. Sample and instrumental factors affecting the DTA exotherms were examined. In addition, observations were made of the effect of high temperature anneals on the peak shape of the DTA exotherms. These observations suggested that amorphous B_2O_3 on boron plays a key role as a protective coating, and also may act at temperatures above 675°C as a flux which enhances the reaction of finely divided boron with the calcium chromate particles.

17340 **(UCRL-Trans—11661) Initiation of explosives: a multi-layered problem in detonation physics.** Held, M. Translated from *Explosivstoffe ;* **16**: No. 5, 97-113(May 1980). 57p. NTIS, PC A04/MF A01.

The physical and chemical aspects of the process by which chemical high-energy explosives are detonated are discussed with information on the initiation of chemical reactions, shock wave motion, changes in energy level within the explosive, excitation mechanisms, and pressure build-up, initiation with a shaped-charge jet, shaped detonators, and fuse cords. (LCL)

4502 Nuclear

17341 **(SAND—80-1694) Crater: a computer code for calculating late stage crater formation.** McGlaun, J.M. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01.

CRATER is a computer code that calculates the final configuration of a crater by simulating the ejecta motion, upthrust of material close to the crater, and slumping of unstable portions of the crater. An Eulerian wave-code CSQII models the early stages of crater formation when wave propagation phenomena are important. CRATER is used after the stress transients have propagated out of the domain of interest and the ejecta flow field is established. CRATER uses the CSQII results as initial conditions and simplifies the problem by neglecting all forces acting on the ejecta except gravitational forces. Each material particle is assigned a ballistic trajectory which determines where it lands. While the ejecta are landing, the upthrust of material around the crater is also being simulated. After the ejecta have landed and the upthrust has finished, a crater and lip are formed which may not be stable. A slumping algorithm is included in CRATER to treat unstable portions of the crater or lip.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 17378, 17497, 17893

17342 **(BNL—29260) Marine boundary layer wind structure over the Bay of Bengal during MONEX79.** SethuRaman, S. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 5p. (CONF-810133—1). NTIS, PC A02/MF A01.

From International symposium on early results of FGGE-MONEX experiments; Tallahassee, FL, USA (12 Jan 1981).

A marine boundary layer experiment was conducted at Digha, West Bengal, India, to determine the role of the atmospheric boundary layer on the Bay of Bengal cyclogenesis. The boundary layer experiment at Digha consisted of three main components: (1) a 10 m micrometeorological tower at the beach with instruments to observe turbulent fluxes of heat and momentum over the ocean; (2) a weather station that continuously recorded mean parameters; and (3) pilot balloon observations to a height of about 1000 m. The purpose of this paper is to discuss some of the preliminary results obtained through the analysis of the data.

17343 **(CONF-8005149—1) Fundamental spectroscopic studies of some atmospheric pollutants.** Findley, G.L.; McGlynn, S.P. (Louisiana State Univ., Baton Rouge (USA). Choppin Chemical Labs.). 1980. Contract AS05-76EV03018. 5p. NTIS, PC A02/MF A01.

From Physics and chemistry of energy - related atmospheric pollution; Harpers Ferry, WV, USA (28 May 1980).

Molecular electronic transitions that lie in the vuv (vacuum ultraviolet) spectral region initiate many harmful photochemical modifications in the upper atmosphere. Consequently, investigations have focused on molecules that are primary atmospheric pollutants, but which are simple enough structurally to yield detailed photophysical information. Terminal electronic states for vuv transitions can be either valence or Rydberg and, at low enough energies, the distinction between the two becomes fuzzy. A major thrust of this program has been the classification and characterization of Rydberg transitions in an attempt to gain insight into Rydberg/valence state mixing Rydberg studies. It is concluded that in order to understand the nature of photochemical reactions of molecules in the upper atmosphere, it is necessary to understand the structure and function of high-energy molecular electronic states. It is also necessary to understand the ways in which these states interact and, thereby, facilitate energy transfer. The study of molecular Rydberg states provides information crucial to such an understanding.

17344 **(PB—80-219413) Quantitative separation of asbestos in environmental samples. Final report, August 1978-August 1979.** Peters, E.T.; Smith, E.M. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Aug 1980. Contract EPA-68-02-2967. 55p. NTIS, PC A04/MF A01.

Evaluations were made of a novel approach for separating chrysotile asbestos from other particulate matter to improve the application and detection limit of a broad beam x-ray diffraction analysis method developed by the Naval Research Laboratory. The separation method is based on Selective Nucleation of Crystal Growth (SNCG) whereby treatment of a particulate sample with a special reagent results in the nucleation and growth of crystals along asbestos fibers but not on other matter. The fibers can be thereby increased substantially in mass, volume and density. The reagent previously developed for chrysotile asbestos consists of mixed salts of AgI and KI in ethylene glycol-acetone-water solution, with AgI crystals (density of 5.67 g/cc) being the decorating agent. Attempts to develop a comparable reagent for amphibole asbestos were unsuccessful. Minerals structurally or chemically related to chrysotile gave no reagent response except for moderate response by lizardite and slight response from antigorite. Mixed mineral samples consisting of known amounts of chrysotile and quartz were reagent-treated, resulting in AgI overgrowths of up to 25 micrometers in diameter. Separation of the decorated asbestos from quartz by a high density liquid with and without centrifugation and by Stokes settling more unsuccessful; recoveries of about 50 percent of both chrysotile and quartz were found in the separated fraction. Further work is required to improve the separation process.

17345 **(UCRL—84672) Observed turbulence intensities in a desert boundary layer.** Shinn, J.H.; Cederwall, R.T. (Lawrence Livermore National Lab., CA (USA)). Oct 1980. Contract W-7405-ENG-48. 3p. (CONF-810306—6). NTIS, PC A02/MF A01.

From 5. symposium on turbulence, diffusion, and air pollution; Atlanta, GA, USA (9 Mar 1981).

A number of applied problems in atmospheric dispersion require the prediction of vertical and lateral turbulence intensities near the ground as a function of the local atmospheric stability. The σ/sub w//u/sub */ was investigated over a wide range of stabilities at two desert sites in Nevada and California. The study was part of a meteorological baseline for field tests of atmospheric dispersion during liquified natural gas (LNG) spills. The data collected at Frenchman Flat (Nevada Test Site) during neutral and stable cases seem to be remarkably different from those of other published studies and lead to the hypothesis that, under certain conditions, different semi-empirical approaches would be required to predict turbulence intensities.

17346 **(UR—3490-1979) Similarity theory for aerosol beams.** Dahneke, B.; Hoover, J.; Cheng, Y.S. (Rochester Univ., NY (USA)). 1980. Contract AC02-76EV03490. 30p. NTIS, PC A03/MF A01.

A similarity theory is found to exist for aerosol beams of sufficiently small particles when the beams are generated by laminar, isentropic, continuum expansions. Since this theory describes the complete dynamics of the beam particles, it can be used to determine any property of an aerosol beam such as particle terminal velocity or TOF over a fixed path length or particle transmission efficiency through a collimating hole. For the small particles for which the similarity theory applies, these beam properties depend uniquely on a dimensionless similarity variable β. This similarity variable provides by itself substantial insight into the properties of aerosol beams because it reveals the functional dependence of the beam properties on the various particle, gas and nozzle parameters. For large particles the beam properties depend on several variables rather than a single similarity variable. Nevertheless, the qualitative behavior of beams of large particles is indicated by the behavior of beams of small particles. The collimation separation process for isolating beam particles of selected size is discussed. Particle aerodynamic diameter is expressed in terms of β.

17347 **General circulation experiment with a coupled atmosphere, ocean and sea ice model.** Washington, W.M.; Semtner, A.J. Jr.; Meehl, G.A.; Knight, D.J.; Mayer, T.A. (National Center for Atmospheric Research, Boulder, Colorado 80307). *Journal of Physical Oceanography ;* **10**: No. 12, 1887-1908(Dec 1980).

This paper describes the construction and results of a comprehensive, three-dimensional general circulation model (GCM) of the earth's climate. The model, developed at the National Center for Atmospheric Research (NCAR), links separate existing models of the atmosphere, ocean and sea ice. The atmospheric model is a version of the third-generation NCAR GCM which has a relatively complete treatment of physical processes. It uses a generalized vertical coordinate with eight layers (~3 km thick) and 5° horizontal grid spacing over the entire globe. The ocean model, using the primitive equations and the hydrostatic and Boussinesq approximations, was changed to the world domain from an earlier model developed by Bryan (1969) and reprogrammed by Semtner (1974). The model has four unequally spaced vertical layers and 5° horizontal grid structure. The sea ice model is a simple thermodynamic model using a simplified calculation of heat flux through sea ice (Semtner, 1976).

17348 **Cape Canaveral sea breezes.** Reed, J.W. (Sandia Labs., Albuquerque, NM). *Journal of Applied Meteorology ;* **18**: No. 2, 231-235(Feb 1979).

Anemometer records from five levels on a 151 m meteorological tower have been analyzed. Results show an approximate elliptical clockwise diurnal oscillation of the sea breeze component of the wind. The oscillation amplitude increases with height; it is largest in May and smallest in January.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 16413, 16429, 16498, 16502, 17202, 17245, 17248, 17329, 17384, 17390, 17391, 17400, 17438, 17517, 17528, 17905

17349 **(BNL—29271) Seasonal variations in light scattering in the New York region and their relation to sources.** Leaderer, B.P.; Tanner, R.L.; Lioy, P.J.; Stolwijk, J.A.J. (Yale Univ., New Haven, CT (USA). Dept. of Epidemiology and Public Health; Brookhaven National Lab., Upton, NY (USA); New York Univ., NY (USA). Inst. of Environmental Medicine). 1980. Contract AC02-76CH00016. 40p. (CONF-801114—10). NTIS, PC A03/MF A01.

From Symposium on plumes and visibility; Grand Canyon, AZ, USA (10 Nov 1980).

Light scattering data collected during two periods of intensive sampling in New York City (one during summer months and one during winter months) are discussed and analyzed for diurnal patterns, their relationship to pollutant emission sources, meteorological parameters, and the size distribution and chemical composition of the ambient aerosol. The lack of a diurnal pattern for light scattering in summer in combination with a strong positive association with ozone and wind direction dependency suggests that in summer the transport of an aged aerosol in photochemically rich air masses rather than local emissions of primary pollutants is largely responsible for the observed levels of light scattering in New York City. Winter levels of light scattering observed in New York City, while approximately 50% lower than summer levels, were much less dependent on wind direction and closely related to pollutant emissions from local sources. This suggests that locally generated aerosol dominates light scattering in the winter. Particles 0.1μm to 1.3μm in diameter were strongly correlated with light scattering in New York City during both summer and winter periods. However, a given volume of aerosol between 0.1μm and 1.3μm scattered more light in summer than in winter, indicating the fresher nature of the winter aerosol. Variance in dry particulate light scattering was found to principally account for light extinction variance (calculated from airport visibility observations) in summer and winter. Sulfate aerosol was strongly correlated with light scattering during both summer and winter periods.

17350 **(CONF-810346—1) Recent developments in the analysis of air samples by luminescence techniques.** Vo-Dinh, T. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From Instrument Society of America symposium; St Louis, MO, USA (23 Mar 1981).

A report is presented on recent developments in luminescence analysis of atmospheric samples using two simple luminescence methods, the synchronous excitation and the room temperature phosphorescence (RPT) techniques. Samples extracted from high-volume samplers can be analyzed for their content of certain polynuclear aromatic (PNA) compounds using these two spectroscopic methods. The RPT technique also provides a novel approach for direct detection of PNA vapors collected on filter paper.

17351 **(EPRI-CS—1683-SY) Studies on mathematical models for characterizing plume and drift behavior from cooling towers. Executive summary.** Policastro, A.; Dunn, W.; Carhart, R. (Argonne National Lab., IL (USA)). Apr 1981. Contract W-31-109-ENG-38. 15p. NTIS, PC A02/MF A01.

This report summarizes the contents of a five-volume work on new models for predicting plume rise and drift deposition from single and multiple natural-draft and mechanical-draft cooling towers.

17352 **(EPRI-CS—1739) Scrubber-generated particulate: literature survey. Final report.** Maddalone, R.F.; Jackson, B.; Yu, C. (TRW, Inc., Redondo Beach, CA (USA)). Mar 1981. 126p. NTIS, PC A07/MF A01.

The increased use of coal and the parallel growth of flue gas desulfurization (FGD) systems to remove SO_2 and particulate matter has fostered a concern over the potential emissions from the FGD system. The most prevalent type of FGD system is wet scrubbers that use a variety of alkaline solutions and gas contact schemes to remove the SO_2 from the flue gas. This report describes

the results of a literature survey which compiled the present state of knowledge about scrubber-generated particulate (SGP). As a part of this search, information on sampling and analysis methods for SGP, mist eliminator entrainment studies, and particle penetration studies was collected. The literature search employed lists of key words to search the Lockheed Information System, DIALOG, and ORBIT. These data bases contained cross-referenced information on NTIS, APTIC, and Chem Abstract data files. These computer searches were supplemented by a manual review of selected documents and by telephone contacts to key individuals. Most of the available literature consisted of studies on penetration by particle size and mist eliminator design and efficiency. Only a few cases of direct information on SGP were found. The information suggests that SGP may represent 10 to 50% of the particulate emitted from an FGD system; however, better sampling and analysis methods are needed to provide a definitive estimate of SGP.

17353 **(LA-UR—80-3052) Drainage flow over complex terrain.** Davis, C.G.; Bunker, S.S.; King, D.S.; Mutschlecner, J.P.; Barr, S.; Clements, W.E. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810306—1). NTIS, PC A02/MF A01.

From 5. symposium on turbulence, diffusion, and air pollution; Atlanta, GA, USA (9 Mar 1981).

Model calculations even carried in order to simulate tracer release experiments at the Geysers Area. Comparisons with the experimental data provide a test of current ability to model pollutant transport. The calculations were carried out with a windfield code (ATMOS1) and an advection-diffusion code (ATMOS2). The resulting concentrations permit prediction of tracer particle collections at the measurement stations. Comparison of the observations and predictions of sequential and integrated counts shows generally good agreement, but with discrepancies in some instances. The method appears to be a useful one for pollutant transport predictions and for parametric studies.

17354 **(LA-UR—81-729) Determination of protection factors for tandem HEPA filters.** Tillery, M.I. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 6p. (CONF-810505—3). NTIS, PC A02/MF A01.

From Institute of Environmental Sciences annual meeting; Los Angeles, CA, USA (4 May 1981).

A theoretica model was combined with performance data to determine probable filter performance with respect to the size characteristics of airborne particles. Maximum and percent penetrations of aerosols particles of four densities are reported. (JGB)

17355 **(LBL—11650) Energy and Environment Division annual report, 1979.** Kessel, J.; Osowitt, M. (eds.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1980. Contract W-7405-ENG-48. 446p. NTIS, PC A19/MF A01.

Research progress for 1979 is summarized in short reports in the following areas: Energy Analysis Program; Energy Efficient Buildings Program; Solar Energy Program; Chemical Process Research and Development Program; Environmental Research Program; conbustion research; effects of pollutants on biological systems; atmospheric aerosol research; and applied research in laser spectroscopy and analytical techniques. Items within the scope of EDB have been entered individually. (ACR)

17356 **(LBL—12199) Organic contaminants: a bibliography.** Lepman, S.R.; Miksch, R.R.; Hollowell, C.D. (Lawrence Berkeley Lab., CA (USA)). Jan 1981. Contract W-7405-ENG-48. 98p. (EEB-Vent—81-4). NTIS, PC A05/MF A01.

The bibliography contains 449 references pertaining to the following research areas: laboratory techniques for analyzing formaldehyde; methodologies for identifying and characterizing a wide variety of organic contaminants; and selected field studies of organic contaminants in indoor air.

17357 **(PB—80-205610) Incentives for technological innovation in air pollution reduction: an ETIP policy research series. Volume 5: an annotated bibliography of literature on market mechanisms and economic incentives for environmental regulation. Final report.** Watson, S. (Performance Development Inst., Washington, DC (USA)). Apr 1980. Contract NBS-78-3603. 32p. NTIS, PC A03/MF A01.

This bibliography cites and annotates literature regarding market mechanisms and economic incentives for environmental regulation. References emphasize air pollution and stationary source regulation. Primary attention is given to regulatory tactics that could entail internal or external trading in emission reductions, such as emission fees are included but not emphasized. Scholarly literature as well as government reports and articles from other sources are included in the bibliography.

17358 **(PB—80-209778) Reference method 24-determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings. Reference method 25-determination of total gaseous nonmethane organic emissions as carbon. Background information for promulgated test methods. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Emission Standards and Engineering Div.). Jul 1980. 22p. NTIS, PC A02/MF A01.

Reference Method 24 is used to determine the volatile organic compound (VOC) content of coating materials, and Reference Method 25 is used to determine the percentage reduction of VOC emissions achieved by emission control devices. These methods were proposed on October 5, 1979, as an appendix to the proposed standards of performance for automobile and light-duty truck surface coating operations. This document contains information on the public comments made after proposal and EPA responses to the comments.

17359 **(PB—80-210800) Transportation systems and regional air quality - photochemiCal modeling of Sacramento, California region. Interim report, April 1976-October 1979.** Squires, B.T.; Bushey, R.W.; Shirley, E.C. (California State Dept. of Transportation, Sacramento (USA). Transportation Lab.). Feb 1980. 175p. NTIS, PC A08/MF A01.

In cooperation with the California Air Resources Board and the Sacramento Regional Area Planning Commission, regional modeling was performed simulating a high ozone day in Sacramento, California. The study area was selected to include populate sections of Sacramento. An air pollution emission inventory was taken for the study area. Field gathering of meteorologic and aerometric data was done in the summer of 1976. Verification of two models, the SAI 15-step chemistry and the SMOG models was attempted. A verification was not effected with the SAI model, but the SMOG model seemed to verify. Problems involved with the use of each model are discussed as are the unique properties of the models. The SMOG model results depended significantly more on initial conditions than on emission levels.

17360 **(PB—80-212129) Durability demonstration of systems for control of sulfuric acid. Final report, November 1976-September 1979.** Ingalls, M.N. (Southwest Research Inst., San Antonio, TX (USA)). Nov 1979. Contract EPA-68-03-2481. 377p. NTIS, PC A17/MF A01.

The report describes development testing, optimization, and durability testing of emission control systems capable of meeting 1981 gaseous emission standards while maintaining low sulfate emissions. Four emission control systems were investigated (1) oxidation catalyst with air modulation system, (2) high temperature exhaust system, (3) threeway catalyst with feedback carburetor, and (4) threeway plus oxidation with air modulation system and feedback fuel injection. In Phase I of the project, the air modulation system and the threeway catalyst system were selected for optimization and durability testing. The usual gaseous emissions, plus nonmethane hydrocarbons, total cyanide and ammonia were measured on both systems. The oxidation system was operated on a test car for 24100 km and the threeway catalyst system for 32200 km, with emission tests every 8050 km. The durability distance accumulation was halted on both cars because emissions levels exceeded the 1981 standards. In Phase II of the project, a threeway plus oxidation

catalyst system was developed, optimized and tested for durability for 64,400 km. During the durability testing, emissions tests were performed every 8050 km.

17361 **(PB—80-213119) The RAPS (regional air pollution study) helicopter air pollution measurement program, St. Louis, Missouri, 1974-76. Final report.** Mage, D.T.; Evans, R.B.; Fitzsimmons, C.; Hester, N.; Johnson, F. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Dec 1979. 208p. NTIS, PC A10/MF A01.

This research program was initiated with the overall objective of providing measurement of air pollution and temperature gradient over the St. Louis, Missouri/Illinois, metropolitan area to complement surface measurements of air pollution by the Regional Air Monitoring System (RAMS) of the Regional Air Pollution Study (RAPS). This report describes in detail the helicopter data collection program and catalogs the missions flown by date, time, flight pattern and purpose. These data, collected on magnetic tape, are deposited in the RAPS data bank maintained by the U.S. Environmental Protection Agency. Sufficient examples are provided, with figures and tables, to enable the prospective users of these data to understand the measurements and their limitations and to facilitate usage of the data bank.

17362 **(PB—80-219421) Environmental assessment of a waste-to-energy process: Braintree municipal incinerator.** Golembiewski, M.; Ananth, K.; Trischan, G.; Baladi, E. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1980. Contract EPA-68-02-2166. 230p. NTIS, PC A11/MF A01.

Midwest Research Institute conducted an array of field tests at the Braintree Municipal Incinerator facility in Braintree, Massachusetts, for the purpose of providing data on multimedia emissions to help determine adverse environmental impact and pollution contol technology needs. There are two incinerators at the Braintree facility; both are of the waterwall type and are designed to burn unprocessed mixed municipal refuse at a rate of 120 tons/day each. Air pollution control is provided by electrostatic precipitators. Primary emphasis was placed on evaluating air emissions. Analyses were carried out for criteria pollutants (particulates, NOx, SO2, CO, and hydrocarbons) as well as for potentially hazardous compounds such as polychlorinated biphenyls and polycyclic aromatic hydrocarbons. The Environmental Protection Agency-designed Source Assessment Sampling System train was also used as per the Environmental Protection Agency's Level 1 environmental assessment protocol. The data obtained were used to evaluate emissions in each effluent stream on the basis of existing standards or criteria and also through the use of the Environmental Protection Agency's recently devised Source Analysis Model (SAM-1A).

17363 **(PB—80-219546) Compilation of environmental assessment data, February 1978-March 1979. Volume I. Studies 1-7. Final report, February 1978-March 1979.** Sexton, N.G.; Southerland, L.I. (Research Triangle Inst., Research Triangle Park, NC (USA). Systems and Measurements Div.). Jul 1980. Contract EPA-68-02-2688. 614p. NTIS, PC A99/MF A01.

The three-volume report compiles all data from EPA/IERL-RTP's phased environmental assessment program for the period 2/78-3/79. It includes data from 14 environmental assessment studies, compiled in standard format. The formatted Level 1 data are organized within each study by the analytical technique used to generate the data. Inorganic data as generated by spark source mass spectroscopy, atomic absorption, gas chromatography, chemiluminescence for oxides of nitrogen, anion analysis, and aqueous analysis precede the organic data generated by gas chromatography for C1-C6/C7 or C7-C17, liquid chromatographic fractionation, infrared spectroscopy, and low resolution mass spectroscopy. Sampling and analytical techniques that were used, that are not specified in Level 1, are documented in the summaries and data pages. Each Level 1 data section is followed by a Level 2 data section and/or an additional data section. Tables and figures in the Level 2 and additional data sections have been reproduced from the documents originally published by the organization conducting the study. The studies are organized by industrial type: (Vol. I) chemically active fluidized-bed combustion, coal-fired boiler and oil-fired boiler, coal-fired power plant, and coal gasifier.

17364 **(PB—80-219553) Compilation of environmental assessment data, February 1978-March 1979. Volume II. Studies 8 and 9. Final report, February 1978-March 1979.** Sexton, N.G.; Southerland, L.I. (Research Triangle Inst., Research Triangle Park, NC (USA). Systems and Measurements Div.). Aug 1980. Contract EPA-68-02-2688. 421p. NTIS, PC A18/MF A01.

The three-volume report compiles all data from EPA/IERL-RTP's phased environmental assessment program for the period 2/78-3/79. It includes data from 14 environmental assessment studies, compiled in standard format. The formatted Level 1 data are organized within each study by the analytical technique used to generate the data. Inorganic data as generated by spark source mass spectroscopy, atomic absorption, gas chromatography, chemiluminescence for oxides of nitrogen, anion analysis, and aqueous analysis precede the organic data generated by gas chromatography for C1-C6/C7 or C7-C17, liquid chromatographic fractionation, infrared spectroscopy, and low resolution mass spectroscopy. Sampling and analytical techniques that were used, that are not specified in Level 1, are documented in the summaries and data pages. Each Level 1 data section is followed by a Level 2 data section and/or additional data section. Tables and figures in the Level 2 and additional data sections have been reproduced from the documents originally published by the organization conducting the study. The studies are organized by industrial type: (Vol. II) coke production, and ferroalloy process.

17365 **(PB—80-219561) Compilation of environmental assessment data, February 1978-March 1979. Volume III. Studies 10-14. Final report, February 1978-March 1979.** Sexton, N.G.; Southerland, L.I. (Research Triangle Inst., Research Triangle Park, NC (USA). Systems and Measurements Div.). Aug 1980. Contract EPA-68-02-2688. 384p. NTIS, PC A17/MF A01.

The three-volume report compiles all data from EPA/IERL-RTP's phased environmental assessment program for the period 2/78-3/79. It includes data from 14 environmental assessment studies, compiled in standard format. The formatted Level 1 data are organized within each study by the analytical technique used to generate the data. Inorganic data as generated by spark source mass spectroscopy, atomic absorption, gas chromatography, chemiluminescence for oxides of nitrogen, anion analysis, and aqueous analysis precede the organic data generated by gas chromatography for C1-C6/C7 or C7-C17, liquid chromatographic fractionation, infrared spectroscopy. Sampling and analytical techniques that were used, that are not specified in Level 1, are documented in the summaries and data pages. Each Level 1 data section is followed by a Level 2 data section and/or an additional data section. Tables and figures in the Level 2 and additional data sections have been reproduced from the documents originally published by the organization conducting the study. The studies are organized by industrial type: (Vol. III) the remaining industrial processes.

17366 **(PB—80-220320) Protecting visibility: an EPA report to Congress. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Oct 1979. 265p. NTIS, PC A12/MF A01.

This report is prepared in response to the requirements of Section 169A(a) of the Clean Air Act. It discusses methods for meeting the visibility goal, including methods for determining visibility impairment, modeling and other methods for evaluating source impacts, methods for preventing and remedying pollution-derived visibility impairment, and pollutants and sources that may impair visibility.

17367 **(PB—80-220833) CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Model-simulation.** Benson, P.; Baishiki, R. (California State Dept. of Transportation, Sacramento (USA). Transportation Lab.). 29 Feb 1980. mag tap. Source tape is in EBCDIC character set. Tapes can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, track, density, and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB—80-220841. Also available as punched cards.

CALINE3 is a third generation line source air quality model developed by the California Department of Transportation. It is based on the Gaussian diffusion equation and employs a mixing zone concept to characterize pollutant dispersion over the roadway. The purpose of the model is to assess air quality impacts near transportation facilities in what is known as the microscale region. Given source strength, meteorology, site geometry, and site characteristics, the model can reliably predict carbon monoxide concentrations for receptors located within 150 meters of the roadway. The model has adjustments for averaging time and surface roughness, and can handle up to 20 links and 20 receptors. It also contains an algorithm for deposition and settling velocity so that particulate concentrations can be predicted.

17368 **(PB—80-220841) CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Interim report.** Benson, P.E. (California State Dept. of Transportation, Sacramento (USA). Transportation Lab.). Nov 1979. 182p. NTIS, PC A09/MF A01.

Development and use of the 3rd generation California Line Source Dispersion Model, CALINE3, is described. This model can be used to predict carbon monoxide concentrations near highways and arterial streets given traffic emissions, site geometry and meteorology. The model has adjustments for averaging time and surface roughness, and can handle up to 20 links and 20 receptors. It also contains an algorithm for deposition and settling velocity so that particulate concentrations can be predicted. Detailed sensitivity and verification analyses are contained in the report. Also, user instructions containing four example applications of the model are included. The model is available in Fortran and BASIC languages. An abbreviated version for use on HP-67/97 and TI-59 programmable calculators is also listed in the report.

17369 **(PB—80-221237) Health impacts, emissions, and emission factors for noncriteria pollutants subject to de minimis guidelines and emitted from stationary conventional combustion processes.** Ackerman, D.G.; Haro, M.T.; Richard, G.; Takata, A.M.; Weller, P.J. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Jun 1980. Contract EPA-68-02-3138. 106p. NTIS, PC A06/MF A01.

The report presents a literature survey of the health and ecological effects associated with various air quality levels of noncriteria pollutants that are regulated under the Clean Air Act. These noncriteria pollutants include mercury, beryllium, asbestos, sulfuric acid mist, vinyl chloride, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, carbon disulfide and carbon sulfide. Nationwide emissions are estimated for each noncriteria pollutant with particular emphasis on contributions from fossil fuel combustion at stationary sources. Factors for quantifying emissions from fossil fuel combustion processes are discussed for each noncriteria pollutant.

17370 **(PB—80-221674) Measurement of volatile organic compounds. Guideline series.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1979. 68p. NTIS, PC A04/MF A01.

This document discusses the rationale of total volatile organics stationary source emission measurement through the determination of organic carbon mass concentration. A conceptual approach for writing emission regulations in terms of volatile organic carbon is recommended, and drafts of two specific test methods are presented for regulation implementation. The methods are the measurement of total gaseous nonmethane organics as carbon by the chromatographic oxidation/reduction procedure, and the relative organic measurement derived by direct application of the flame ionization analyzer.

17371 **(PB—80-221708) Effects of air emissions on wildlife resources. Air pollution and acid rain report No. 1.** Newman, J.R. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). May 1980. 43p. NTIS, PC A03/MF A01.

This publication describes in general the pathways of contamination, direct and indirect effects of air emissions on wildlife resources, and the potential use of wildlife as biological indicators of air quality degradation. Also included in the report are summaries of air pollution incidents involving wildlife, responses of wildlife to air pollution, major target systems of selected air pollutants, and information on the capacity of some air pollutants to accumulate in body tissues.

17372 **(PB—80-222532) National emissions report, 1977: national emissions data system of the aerometric and emissions reporting system. Annual report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Mar 1980. 437p. NTIS, PC A19/MF A01.

The National Emissions Report summarizes annual cumulative estimates of source emissions of five criteria pollutants: particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide. Summary data are presented for the nation as a whole, for individual states, and for Air Quality Control Regions and individual interstate portions thereof.

17373 **(PB—80-223514) Health hazard evaluation determination report: HE 79-124-682: Orlando International Airport, Orlando, Florida.** Moseley, C.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1980. 10p. NTIS, PC A02/MF A01.

On July 23, 1979, NIOSH received a request for a health hazard evaluation from the President of the Orange County Police Benevolent Association. The request concerned exposure of airport security personnel (SIC code 4583) to emissions from automobiles, buses and airplanes, which were reported to be causing respiratory problems. Area air sampling did not detect concentrations of sulfur dioxide (SO2), oxides of nitrogen (NOx), respirable particulate, total volatile hydrocarbons, polynuclear-aromatic-hydrocarbons (PAH's) or CO expected to cause the reported health complaints. SO2 values were less than 0.4 mg/cu m, NOx less than 0.1 mg/cu m, respirable particulate less than 0.2 mg/cu m, total volatile hydrocarbons nondetectable, and PAH's less than 0.2 mg/cu m. Based on environmental and medical data and observations, NIOSH has determined that a health hazard to security personnel did not exist. However, in order, to make working conditions more bearable, it is recommended that a more structured inside/outside work regimen be instituted.

17374 **(PB—80-813462) Air quality monitoring. 1977-1978 (citations from the NTIS data base). Report for 1977-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Jul 1980. 221p. NTIS PC N01/MF N01.

This bibliography discusses major studies on air pollution monitoring, including site selection, operation criteria, design criteria, calibration, and performance evaluation of the technique or equipment. Different types of pollutants from various sources are covered. (This updated bibliography contains 215 citations, none of which are new entries to the previous edition.)

17375 **(PB—80-813470) Air quality monitoring. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 130p. NTIS PC N01/MF N01.

The citations from Federally funded research discuss major studies on air pollution monitoring, including site selection, operation criteria, design criteria, calibration, and performance evaluation of the technique or equipment. Different types of pollutants from various sources are covered. (This updated bibliography contains 125 abstracts, 89 of which are new entries to the previous edition.)

17376 **(PB—80-814478) Pollution caused by ammunition manufacturing. 1964-July 1980 (citations from the NTIS data base). Report for 1964-July 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 264p. NTIS PC N01/MF N01.

The bibliography covers air, water, and solid pollution produced by munition plants. The citations include monitoring, chemical analysis, cost analysis, pollution control techniques, equipment used, and toxicity studies. (This updated bibliography contains 253 citations, 17 of which are new entries to the previous edition.)

17377 (PNL—3700(Pt.5), pp 11-16) **Regional impacts.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The principal work conducted by Pacific Northwest Laboratory for the Regional Assessment Division was analysis of the consequences from and constraints applicable to the possible use of a specified mix of energy tecnologies in the Pacific Northwest Region. Included in this work were improvements in the use of models of long-range transport of sulfur oxides and fine particulates and research improvements in Regional Issues Identification and Assessment for improvements in areas of energy policy and energy plans. (DLS)

17378 **(UCID—18997) Scenarios for future anthropogenic emissions of trace gases in the atmosphere.** Wuebbles, D.J. (Lawrence Livermore National Lab., CA (USA)). Apr 1981. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01.

An assessment was made of possible future changes to the atmospheric concentrations of CO, CO_2, N_2O, CH_4 and NO/sub x/ (= NO + NO_2). The assessment was based on the current understanding of the processes that determine the atmospheric sources of these species and the potential for anthropogenic influence. Since economics limits the number of scenarios that can be calculated, the discussion focuses on determining the most reasonable future growth scenario of each species. Large uncertainties exist particularly when one extrapolates potential anthropogenic emissions for these species into the next century.

17379 **Pathways of pollutants in the atmosphere.** London, England; Royal Society (1979). 170p. (CONF-7711147—). NTIS (US Sales Only), PC A09/MF A01.

From Meeting on pollution in the atmosphere; London, UK (3 Nov 1977).

This book contains papers presented at a two-day Discussion Meeting organized through the Society's Study Group on Pollution in the Atmosphere, and held in November 1977 in the rooms of the Royal Society. Most of these papers deal with selected problems in the elucidation of atmospheric pathways for a number of important pollutants on a local, regional or global scale, involving atmospheric physics and chemistry as well as general meteorology in the lower atmosphere and the stratosphere. The ultimate objective of scientific research about pollution lies in the need to formulate policies for control, which to make sense require a rational basis for the assessment of risk. Consequently the late papers in the volume deal with impacts on targets, with the monitoring of pollution, and with the approach adopted in the United Kingdom to control policy.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 17351, 17401, 17406, 17411, 17421

17380 (CONF-791234—, pp 9-14) **Fission-product source terms.** Lorenz, R.A. (Oak Ridge National Lab., TN). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

This presentation consists of a review of fission-product source terms for light water reactor (LWR) fuel. A source term is the quantity of fission products released under specified conditions that can be used to calculate the consequences of the release. The source term usually defines release from breached fuel-rod cladding but could also describe release from the primary coolant system, the reactor containment shell, or the site boundary. The source term would be different for each locality, and the chemical and physical forms of the fission products could also differ.

17381 (CONF-791234—, pp 15-33) **Atmospheric release advisory capability.** Sullivan, T.J. (Lawrence Livermore Lab., CA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The ARAC system (Atmospheric Release Advisory Capability) is described. The system is a collection of people, computers, computer models, topographic data and meteorological input data that together permits a calculation of, in a quasi-predictive sense, where effluent from an accident will migrate through the atmosphere, where it will be deposited on the ground, and what instantaneous and integrated dose an exposed individual would receive.

17382 (CONF-791234—, pp 34-40) **Ground verification of airborne monitor survey.** Haywood, F.F. (Oak Ridge National Lab., TN). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The work discussed is part of an overall program conducted by the Off-Site Pollutant Measurements Group of Oak Ridge National Laboratory's Health and Safety Research Division. The principal activity of the group is to perform radiological characterization surveys at a number of facilities that were utilized in the early days of the country's atomic energy program. These were associated with the Manhattan Engineer District (MED) and the Atomic Energy Commission (AEC). The location of sites of formal surveys that have been completed in this program, or that are in progress at the present time, are listed. ORNL staff members have performed some of these surveys; others have been conducted by the Argonne National Laboratory and the Los Alamos Scientific Laboratory. The area for ORNL generally extends in a triangular fashion from St. Louis, Missouri, down to Tampa, Florida, and up to Beverly, Massachusetts.

17383 **(DP—1583) Calculation of particulate dispersion in a design-basis tornadic storm from the Battelle Memorial Institute, Columbus, Ohio.** Pepper, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Oct 1980. Contract AC09-76SR00001. 24p. NTIS, PC A02/MF A01.

A three-dimensional numerical model is used to calculate ground-level air concentration and deposition (due to precipitation scavenging) after a hypothetical tornado strike at the Battelle Memorial Institute at Columbus, Ohio. Plutonium particles less than 20 μm in diameter are assumed to be lifted into the tornadic storm cell by the vortex. The rotational characteristics of the tornadic storm are embedded within the larger mesoscale flow of the storm system. The design-basis translational wind value is based on probabilities associated with existing records of tornado strikes in the vicinity of the plant site. Turbulence exchange coefficients are based on empirical values deduced from experimental data in severe storms and from theoretical assumptions obtained from the literature. The method of moments is used to incorporate subgrid-scale resolution of the concentration within a grid cell volume.

5005 Site Resource And Use Studies

17384 **(PB—80-205792) Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978.** Ragland, K.W.; Goodell, B.D.; Coughlin, T.L. (Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering). May 1980. 117p. NTIS, PC A06/MF A01.

Concentrations of dry deposition of sulfur dioxide were investigated near a new 540-MW coal-fired generating station located in a rural area 25 miles north of Madison, Wisconsin. Monitoring data for 2 yr before the start-up in July 1975 and for the year 1976 were used to assess the impact of the plume and to investigate the hourly performance of the Gaussian plume model.

17385 (PNL—3700(Pt.5), pp 59) **Handbooks on effluent and environmental monitoring.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

An updating of the Guide for Environmental Radiological Monitoring at DOE Installations was submitted to the Department of Energy (DOE) Environmental Protection Branch for comment. Issue of the draft Guide for Effluent Monitoring at DOE Installations was again delayed because of further regulatory requirements. An analysis and evaluation of CY 1978 annual environmental surveillance reports from DOE nuclear sites was submitted to the Environmental Protection Branch. A draft Executive Summary of 1978 environmental impacts from all DOE nuclear sites was 90% completed.

5006 Regulations

17386 (ANL/EES-TM—103) **New source performance standards for industrial boilers. Volume 1. Analysis of fuel use implications.** Placet, M.; Heller, J.N. (Teknekron, Inc., McLean, VA (USA)). Jan 1981. Contract W-31-109-ENG-38. 140p. NTIS, PC A07/MF A01.

A review of the Industrial Fuel Choice Analysis Model (IFCAM) led to several concerns: first, the retirement rate used in the model seems to overestimate retirement levels, thus overstating the potential for coal penetration in the industrial sector. Also, the coal transportation rate is assumed to increase by 15% between 1978 and 1985 and remain constant thereafter. In light of recent rate increase approvals the expected price escalation of labor and materials used in railroad expansion, the currently assumed rail rate escalators seem too low. Additionally, the model does not deal with the issue of substitution of small boiler combinations for large boilers. Both promulgation and enforcement may provide incentives for installation of small boiler combinations. For IFCAM to reflect this phenomenon, alternative assumptions and model modifications are suggested. Fuel price projections, the capacity utilization distribution, boiler size distribution, and translation of costs into model algorithms are considered.

17387 (PB—80-205024) **Incentives for technological innovation in air pollution reduction: an ETIP policy research series. Volume 3: opportunities for innovation: administration of sections 111(j) and 113(d) (4) of the Clean Air Act and industry's development of innovative control technology. Final report.** Evans, J. (Performance Development Inst., Washington, DC (USA)). Apr 1980. Contract NBS-78-3603. 107p. NTIS, PC A06/MF A01.

The report describes the administration of two provisions of the Clean Air Act Amendments of 1977, Section 111(j) and 113(d)(4), which allow short-term emissions violations by companies installing innovative technology for air pollution reduction. The waivers are intended to induce industry to risk development of better air pollution control technology without the fear of prosecution or penalties for emissions violations expected during the debugging of innovative technology. The report has four parts: review of legislation and statutory requirements; review of the administration of these sections as reported by EPA and regulated companies; summary and observations resulting from these reviews; and, presented as an annex, a detailed case study of one Section 111(j) waiver application.

17388 (PB—80-206980) **Economic impact of implementing RACT (reasonably available control technology) guidelines in the state of Kentucky. Final report.** (Booz-Allen and Hamilton, Inc., Florham Park, NJ (USA). Foster D. Snell Div.). Apr 1979. Contract EPA-68-02-2544. 431p. NTIS, PC A19/MF A01.

The economic impact was assessed for the following categories of industrial hydrocarbon emissions; surface coating (paper, fabrics, automobiles, metal furniture; and large appliances); solvent metal cleaning; petroleum refineries; bulk gasoline terminals; bulk gasoline plants; storage of petroleum liquids in fixed roof tanks; gasoline dispensing stations--Stage I; and use of cutback asphalt. Also assessed was the economic impact of imposing sulfur dioxide emissions limits representing RACT on fuel combustion sources. The scope of this project was to determine the costs and direct impact of control to achieve RACT limitations for these industrial categories in Kentucky.

17389 (PB—80-212111) **Asphalt roofing manufacturing industry - background information for proposed standards. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Emission Standards and Engineering Div.). Jun 1980. 419p. NTIS, PC A18/MF A01.

Standards of Performance for the control of emissions from the asphalt roofing manufacturing industry are being proposed under Section 111 of the Clean Air Act. These standards would apply only to saturators, blowing stills, storage tanks, and mineral handling and storage operations in asphalt roofing plants, and blowing stills and storage tanks in oil refineries and asphalt processing plants. This document contains background information and environmental and economic impact assessments of the regulatory alternatives considered in developing proposed standards.

17390 (PB—80-212780) **Analysis of options to limit air quality degradation due to misuse of leaded gasoline in cars equipped with catalytic converters. Paper (final).** Dacy, D.; Cutchis, P.; Kuenne, R.; Magnin, J.; Oliver, R. (Institute for Defense Analyses, Arlington, VA (USA). Program Analysis Div.). Oct 1979. Contract EPA-68-01-5150. 67p. NTIS, PC A04/MF A01.

In this study the authors analyze three short-term and eight intermediate-term options to limit the use of leaded gasoline in cars equipped with catalytic converters. The short-term options analyzed are (1) mandated price differential between leaded and unleaded gasoline, (2) temporary suspension of ban on MMT, and (3) increased lead use in leaded gasoline. The intermediate-term options analyzed are (1) delay in introducing the three-way catalytic converter, (2) tax-subsidy schemes, (3) closing down self-service stations, (4) federal law against misfueling, (5) inspection-down self-service stations, (6) public relations program, (7) gasoline rationing, and (8) use of additives and blending materials to increase supply of unleaded gasoline.

17391 (PB—80-212798) **Papers related to gasoline supply, misfueling and environmental air quality for the summer of 1979. Paper (final).** Dacy, D.; Cutchis, P.; Giertz, F.; Kuenne, R.; Magnin, J. (Institute for Defense Analyses, Arlington, VA (USA). Program Analysis Div.). Oct 1979. Contract EPA-68-01-5150. 170p. NTIS, PC A08/MF A01.

This volume contains nine back-up essays to the study, 'Analysis of Options to Limit Air Quality Degradation Due to Misuse of Leaded Gasoline in Cars Equipped with Catalytic Converters,' IDA P-1426. Thus, the essays pertain to the problem of 'misfueling' which was a prominent feature of the gasoline shortage in the summer of 1979.

17392 (PB—80-220734) **Regulatory impact assessment for the September 5, 1979 proposed regulations for prevention of significant deterioration.** Dunbar, D.; Blagun, B.; Gibbs, L.; Carvetti, J.; Wunderle, J. (PEDCo Environmental, Inc., Durham, NC (USA)). Jun 1980. Contract EPA-68-02-3173. 150p. NTIS, PC A07/MF A01.

Report provides a relative impact assessment of several proposed changes to the current prevention of significant deterioration (PSD) regulations. These changes fundamentally affect what sources and modifications must obtain a PSD permit before constructing. The changes include revisions to the definitions of potential to emit, baseline concentration, and major modifications, additional monitoring and BACT requirements, and the inclusion of certain minimum size cutoff for exempting projects from PSD review. The existing regulations and the proposal were compared in terms of number and size of sources subject to review, amount of emissions captured, degree of air quality deterioration, and estimated review costs.

17393 (PB—80-221229) **Impact of proposed and alternative 'de minimis' levels for criteria pollutants.** Dunbar, D.; Blegun, B.; Smith, J. (PEDCo Environmental, Inc., Durham, NC (USA)). Jun 1980. Contract EPA-68-02-3173. 78p. NTIS, PC A05/MF A01.

The report estimates the impact of the prevention of significant deterioration (PSD) regulations under various applicability size cutoffs for criteria pollutant emissions. The analysis is based on the information obtained from completed PSD permitting actions. The report summarizes existing permit data by showing distributions of: (1) emissions levels of criteria pollutants; (2) actual and effective stack heights; (3) maximum downwind air quality impact; and (4) emissions associated with specific air quality impacts.

17394 **(PB—80-221260) Program to prevent the significant deterioration of carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead. Interim report.** Dunbar, D.R.; Paul, R.A. (PEDCo Environmental, Inc., Durham, NC (USA)). Mar 1980. Contract EPA-68-01-4147. 718p. NTIS, PC A99/MF A01.

Section 166 of the 1977 Clean Air Act requires EPA to conduct a study and to promulgate regulations to prevent significant deterioration of air quality resulting from carbon monoxide (CO), volatile organic compounds (VOC) or hydrocarbon (HC), nitrogen oxides (NOx) and lead (Pb). The regulations which are to be promulgated shall provide specific numerical measures against which permit applications may be evaluated. The regulations must also provide a framework for stimulating improved control technology, protection of air quality valves, and the fulfillment of the goals and purposes of the PSD program which are set forth in Section 160 of the Act. This report identifies and evaluates various alternatives for implementing the PSD program and describes in detail a number of issues which need to be resolved in order for the PSD program to be effectively carried out. The report identifies various sources to be affected by the PSD program for CO, VOC or HC, ozone (O3), NOx and Pb. It also provides an assessment of the impact in terms of potential growth which may be precluded as a result of the PSD program for CO, VOC or HC, O3, NOx and Pb as compared to the current PSD program for TSP and SO2. Finally, the report provides an assessment of the potential consequences of no further regulatory action for PSD.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 17497

17395 **(CONF-800160—1) Evolution of mutualism between species.** Post, W.M.; Travis, C.C.; DeAngelis, D.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

From Workshop on differential equations in populations: epidemics and ecology; Clairmont, CA, USA (10 Jan 1980).

Recent theoretical work on mutualism, the interaction between species populations that is mutually beneficial, is reviewed. Several ecological facts that should be addressed in the construction of dynamic models for mutualism are examined. Basic terminology is clarified. (PSB)

17396 **Influence of temperature on nonenzymatic hydrolysis of p-nitrophenyl phosphate in soil.** Neal, J.L.; Linkins, A.E.; Wallace, P.M. (Virginia Polytechnic Inst., Blacksburg, VA). *Communications in Soil Science and Plant Analysis ;* **12**: No. 3, 279-287(1981).

Nonenzymatic hydrolysis of the substrate, p-nitrophenylphosphate used for detection of phosphomonesterase activity in soil, was found to occur. The nonenzymatic hydrolysis of the substrate was temperature dependent; the higher the assay temperature, the greater the amount of hydrolysis. Modifications of the method for determining soil phosphomonesterase are suggested in order to alleviate potential overestimation of phosphomonesterase activity in soil.

17397 **Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations.** Muth, A. (Univ. of Wisconsin, Madison). Contract EY-76-S-02-2270. *Ecology ;* **61**: No. 6, 1335-1343(Dec 1980).

The soil environment imposes constraints on the timing of oviposition and the location of suitable sites for egg burrows of the desert iguana (Dipsosaurus dorsalis). The effects of temperature and water potential on the developmental period and hatching success of eggs were determined. Eggs hatch normally between 28° and 38°C at environmental water potentials between -50 and -1500 kPa. Predictions were derived for the timing and placement of egg clutches based on soil water potential and temperature profiles measured in the field and on the results of laboratory incubation experiments. The results suggest that egg burrows should be located at depths >22 cm in washes or possibly in sparsely vegetated areas away from creosote bushes. The biogeography of desert iguanas within the United States is discussed in relation to soil environments and tolerances of eggs. The physical factors affecting incubation may limit the geographical range of desert iguanas.

17398 **Functional complexity and ecosystem stability.** Van Voris, P.; O'Neill, R.V.; Emanuel, W.R.; Shugart, H.H. Jr. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Ecology ;* **61**: No. 6, 1352-1360(Dec 1980).

The hypothesis that complexity and stability are positively correlated was experimentally tested at the ecosystem level of organization using intact terrestrial microcosms. Power spectral densities of hourly CO_2 efflux, from 11 old-field microcosms, were analyzed for the number of low-frequency components. We postulate that the number of peaks is related to functional interactions among system components (i.e., population interactions, physical-chemical reactions, and biological turnover rates) influenced by nonlinearities, feedbacks, and time delays. Thus, the number of low-frequency peaks can be taken as an index of functional complexity. Relative stability was based on the capacity of the system to retain essential nutrients and was measured by net loss of calcium after the system was stressed with a heavy metal, cadmium. Rank correlation supported the hypothesis that increasing ecosystem functional complexity leads to increasing ecosystem stability.

17399 **Consumer regulation of nutrient cycling.** Kitchell, J.F. (Univ. of Wisconsin, Madison); O'Neill, R.V.; Webb, D.; Gallepp, G.W.; Bartell, S.M.; Koonce, J.F.; Ausmus, B.S. *Bioscience ;* **29**: No. 1, 28-34(Jan 1979).

Nutrient-cycling rates in ecosystems may be altered by translocation and transformation that result from the consumption process and/or the behavior of consumer organisms. Translocation by mobile consumers redistributes nutrients within and between subunits of the ecosystem. Migration of zooplankton and fishes carries nutrients across water-mass boundaries or retards net flux by sedimentation. Bioturbation of sediments and mixing of soil horizons by invertebrates similarly redistribute nutrients across system strata, facilitating utilization by primary producers. Transformation of particle size distribution alters rates of nutrient cycling in proportion to changes in surface/volume relationships. Through selective predation and comminution, consumers regulate rates of nutrient cycling. Nutrient pools comprised of large biomass units (e.g., tree boles, soil litter, lake zooplankton) may be transformed to smaller units, resulting in accelerated nutrient-cycling processes. Small units may be aggregated, for example, as macroarthropod feces or fish biomass, resulting in conservation of nutrients.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 16501, 17329, 17438

17400 **Flax pond ecosystem study: exchanges of CO_2 between a salt marsh and the atmosphere.** Houghton, R.A.; Woodwell, G.M. (Marine Biological Lab., Woods Hole, MA). *Ecology ;* **61**: No. 6, 1434-1445(Dec 1980).

Profiles of CO_2 concentration, windspeed, and temperature were used in the aerodynamic flux technique to calculate the CO_2 exchange between a Long Island salt marsh and the atmosphere. Uptake of CO_2 by the marsh during hours of sunlight and release during the night occurred during all times of the year. The rates of CO_2 exchange were highest during midsummer, 2.3 g $CO_2.m^{-2}.h^{-1}$ averaged over the daylight hours of July, and 1.3 g $CO_2.m^{-2}.h^{-1}$ for both uptake and release. The net 24-h exchange rates followed Spartina growth and senescence during the summer and fall, and

photosynthesis of benthic algae during late winter and spring. There was a net uptake of Co_2 over 24 h by the marsh during all seasons except autumn. The net annual flow of carbon was from the atmosphere to Flax Pond ($\simeq$ 300 g $C.m^{-2}.yr^{-1}$ averaged over the entire marsh ecosystem). This flux was larger than the net exchange of carbon between the marsh and either uplands, sediments, or coastal waters. The net uptake of CO_2 during summer was less than the net productivity of the vascular plants, indicating that some of the CO_2 assimilated by the plants came from heterotrophic respiration within the marsh. Nevertheless, respiration by the plants was by far the largest source of CO_2 from the marsh surface. Nighttime respiration of the ecosystem released a total of $\simeq$ 510 g $C.m^{-2}.yr^{-1}$ to the atmosphere.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 16559, 16578, 16579, 16581, 17450

17401 (CONF-791234—) **Environmental decontamination.** Cristy, G.A.; Jernigan, H.C. (eds.). (Oak Ridge National Lab., TN (USA)). Feb 1981. Contract W-7405-ENG-26. 261p. NTIS, PC A12/MF A01.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The record of the proceedings of the workshop on environmental decontamination contains twenty-seven presentations. Emphasis is placed upon soil and surface decontamination, the decommissioning of nuclear facilities, and assessments of instrumentation and equipment used in decontamination. (DLS)

17402 (CONF-791234—, pp 3-8) **Russian experience.** Trabalka, J.R. (Oak Ridge National Lab., TN). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

Soviet research in terrestrial decontamination appears to have paralleled that of the US in many respects. However, the probability exists that long-term evaluations of decontamination techniques (over 10 to 20 years) have been carried out at one nuclear accident site (a marked divergence from US experience). The area of aquatic decontamination seems to offer the most intriguing possibilities for new information acquisition from the USSR; at this point only its potential importance can be speculated upon.

17403 (CONF-791234—, pp 41-45) **Soil monitoring instrumentation.** Umbarger, C.J. (Los Alamos Scientific Lab., NM). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The Los Alamos Scientific Laboratory (LASL) has an extensive program for the development of nondestructive assay instrumentation for the quantitative analysis of transuranic (TRU) materials found in bulk solid wastes generated by Department of Energy facilities and by the commercial nuclear power industry. Included are wastes generated in decontamination and decommissioning of outdated nuclear facilities, as well as from old waste-burial-ground exhumation programs. The assay instrumentation is designed to have detection limits below 10 nCi/g wherever practicable. The assay instrumentation that is applied specifically to soil monitoring is discussed.

17404 (CONF-791234—, pp 46-60) **LASL experience in decontamination of the environment.** Ahlquist, A.J. (Los Alamos Scientific Lab., NM). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

This discussion represents one part of a major effort in soil decontamination at the Los Alamos site. A contaminated industrial waste line in the Los Alamos townsite was removed, and a plutonium incineration facility, and a filter building contaminated with actinium-227 were dismantled. The former plutonium handling facility has been decontaminated, and canyons and an old firing site contaminated with strontium-90 have been surveyed.

17405 (CONF-791234—, pp 61-70) **Nevada Operations overview.** Church, B.W. (Nevada Operations Office, Las Vegas). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

A brief overview is given of weapon test site decontamination activities carried out by Nevada Operations Office. Tabulated data is given of event name, date, location, year of cleanup, and radioisotopes that were present, activity levels, and cost of cleanup.

17406 (CONF-791234—, pp 71-85) **In situ measurement experiences.** Fritzsche, A.E. (EG and G, Las Vegas, NV). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The Remote Sensing Laboratory, operated by EG and G for the Department of Energy, is prepared to aid in the decontamination process. For many years EG and G has constructed and operated specialized gamma-sensing equipment for the evaluation of radioactive contamination. Many gamma surveys from both aerial and ground vehicles have helped find, identify, and quantify radioactive contamination. Gamma survey data overlaid on EG and G's aerial photographs indicate the location of contamination with a high degree of accuracy. The recent addition of aerial multispectral scanning extends our capability to the determination of environmental effects. EG and G is prepared also to deploy people and equipment quickly for the rapid assessment of nuclear and non-nuclear accidents and spills. Experienced personnel as well as sensing, photographic, and mobile communications gear are available to DOE within hours of a call.

17407 (CONF-791234—, pp 86-90) **Laboratory-field experience.** Johnson, N.R. (Eberline Instrument Corp., Las Vegas, NV). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

A discussion is given about Eberline Corporation's participation in decontamination projects, problems encountered, and solutions to these problems. Over a 30-year period Eberline has established a reputation for radiation protection services and instrumentation. The production of instruments began in 1952, and Eberline has provided radiochemistry, dosimetry, and environmental monitoring services since 1960.

17408 (CONF-791234—, pp 91-99) **Site decontamination.** Bicker, A.E. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

Among the several DOE sites that have been radiologically decontaminated under the auspices of the Nevada Operations Office are three whose physical characteristics are unique. These are the Tatum Dome Test Site (TDTS) near Hattiesburg, Mississippi; a location of mountainous terrain (Pahute Mesa) on the Nevada Test Site; and the GNOME site near Carlsbad, New Mexico. In each case the contamination, the terrain, and the climate conditions were different. This presentation includes a brief description of each site, the methods used to perform radiological surveys, the logistics required to support the decontamination (including health physics and sample analysis), and the specific techniques used to reduce or remove the contamination.

17409 (CONF-791234—, pp 100-103) **Statistical aspects of the cleanup of Enewetak Atoll.** Giacomini, J.J.; Miller, F.L. Jr. (Univ of Nevada, Las Vegas). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The Desert Research Institute participated in the Enewetak Atoll Radiological Cleanup by providing data-base management and statistical analysis support for the Department of Energy team. The data-base management responsibilities included both design and implementation of a system for recording (in machine-retrievable form) all radiological measurements made during the cleanup, excluding personnel dosimetry. Statistical analyses were performed throughout the cleanup and were used to guide excavation activities.

17410 (CONF-791234—, pp 104-109) **Soil decontamination at Rocky Flats Plant.** Thompson, G.H. (Rockwell International, Golden, CO). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

A description is given of work being done at Rocky Flats Plant (RFP) to decontaminate soil contaminated with plutonium-239. How the contamination came about is described, as well as what has been done to contain it while decontamination methods are being developed. The purpose of the work is to decontaminate the soil so that it can be returned to the site instead of having to package, ship, and store it.

17411 (CONF-791234—, pp 135-143) **Cleanup of building 3019 and surroundings at ORNL following plutonium release of November 20, 1959.** Parrott, J.R. Sr. (Oak Ridge National Lab., TN). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

A non-nuclear explosion involving an evaporator occurred in a shielded cell in the Radiochemical Processing Pilot Plant at Oak Ridge National Laboratory on November 20, 1959. Plutonium was released, probably as an aerosol of fine particles of plutonium oxide, via three principal routes: (1) cell ventilation system: collected about 1.5 g, completely removed from the air stream by roughing and absolute filters; (2) the cell door was blown open (but not off) to the outside, releasing approximately 600 mg to a limited area south and east of the building. The Graphite Reactor Building, directly east of Building 3019, was subjected to the highest level of contamination; and (3) pipe passages and service openings through the cell wall resulted in about 70 mg being spread to the building interior. The extent of contamination and the decontamination effort required for resumption of operations is discussed.

17412 (CONF-791234—, pp 144-151) **Surface soil contamination standards for Rockwell Hanford Operations.** Boothe, G.F. (Rockwell Hanford Operations, Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The 200 Areas of the Hanford site contain soils contaminated with levels of radioactivity ranging from fallout concentrations to levels requiring radiological controls. Some contamination is more or less uniformly distributed, and some occurs as discrete specks or spots of activity. Because of the acute need for standards, the Rockwell Environmental Protection (EP) Group proceeded to develop standards; these were approved by Rockwell in October 1979. It must be emphasized that these standards are only applicable to the 200 Areas of the Hanford site or other areas under Rockwell's jurisdiction. It is assumed that access to these areas will always be restricted and that land-use restrictions will be maintained. Contamination limits for areas used by the general public would normally be lower than the limits derived in this case. It appears that the Rockwell standards divided by a factor of 5 to 10 may be reasonable contamination guidelines for the general environment.

17413 (CONF-791234—, pp 152-166) **Soil surface decontamination and revegetation progress.** Graves, A.W. (Rockwell Hanford Operations, Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

A review is given of work by Rockwell Hanford Operations related to large-area decontamination efforts. Rockwell has a Program Office which manages the decontamination and decommissioning (D and D) efforts. Part of the program is involved with large-surface area cleanup in conjunction with surveillance and maintenance of retired sites and facilities. The other part is the decontamination and decommissioning of structures. There are 322 surplus contaminated sites and facilities for which Rockwell has responsibility on the Hanford Site. A Program Office was established for a disciplined approach to cleanup of these retired sites. There are three major projects: the first is surveillance and maintenance of the sites prior to D and D, the project under which the radiation area cleanup is contained. Another project is for contaminated-equipment volume reduction; size reduction with arc saw cut-up and volume reduction with a vacuum furnace meltdown are being used. The third major project is structural D and D.

17414 (CONF-791234—, pp 171-175) **Methods and costs for soil removal.** Toomey, J.E. (Rockwell Hanford Operations, Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

Methods utilized in the surface stabilization of Hanford outdoor radiation areas are discussed. The work is divided into three major tasks: soil transport, surface preparation, and surface stabilization.

17415 (CONF-791234—, pp 176-184) **Atomics International's recent decommissioning experience.** Kittinger, W.D. (Rockwell International, Canoga Park, CA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

A program for decommissioning eight nuclear facilities has been underway by the Atomics International (AI) Division of Rockwell International during the past five years. The facilities are located at the Rockwell Santa Susana Field Laboratory, approximately 30 miles from the center of Los Angeles. The facilities served experimental and development programs for space nuclear power, liquid metal technology, and commercial power generation. The land involved is under lease to the Federal government and may revert to private ownership. The programs conducted in these facilities were terminated in the 1960s, and the facilities were placed in a layaway status. They were designated as being surplus to programmatic needs in the early 1970s, and decommissioning project authorization was received from the government in 1974.

17416 (CONF-791234—, pp 185-194) **Techniques for removing contaminated concrete surfaces.** Halter, J.M.; Sullivan, R.G. (Pacific Northwest Lab., Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

This discussion compares various techniques that have been used to clean concrete surfaces by removing the surface. Three techniques which have been investigated by the Pacific Northwest Laboratory for removing surfaces are also described: the water cannon, the concrete spaller, and high-pressure water jet. The equipment was developed with the assumption that removal of the top 1/8 to 1/4 in. of surface would remove most of the contamination. If the contamination has gone into cracks or deep voids in the surface, the removal processes can be repeated until the surface is acceptable.

17417 (CONF-791234—, pp 215-228) **Idaho National Engineering Laboratory decontamination and decommissioning summary.** Chapin, J.A. (Idaho National Engineering Lab., Idaho Falls). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

Topics covered concern the decontamination and decommissioning (D and D) work performed at the Idaho National Engineering Laboratory (INEL) during FY 1979 and include both operations and development projects. Briefly presented are the different types of D and D projects planned and the D and D projects completed. The problems encountered on these projects and the development program recommended are discussed.

17418 (CONF-791234—, pp 229-235) **Criteria development methodology for DOE decommissioning operations.** Denham, D.H. (Pacific Northwest Lab., Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The Radiological Guide for DOE Decommissioning Operations provides a uniform basis for assessing hazard inventories, making risk analyses, performing site characterizations, and certifying decommissioning operations. While initially addressed to radioactive contaminants, in all likelihood it will be extended to include other contaminants.

17419 (CONF-791234—, pp 236-242) **FUSRAP equipment concept development study.** Hinerman, K.B.; Smith, R.E. (Dalton-Dalton-Newport, Washington, DC). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

Under DOE contract, Dalton-Dalton-Newport, Inc. is performing an engineering evaluation of three selected FUSRAP sites in an effort to generate equipment concepts to perform remedial action for retrieval, packaging, storing, and transporting contaminated soil and other debris. Along with this engineering evaluation, an analysis of state and Federal regulations was made which had significant impact on the selected equipment and costs for each remedial action concept.

17420 (CONF-791234—, pp 243-253) **Machine technology: a survey.** Barbier, M.M. (Scientific Consulting, Herndon, VA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

An attempt was made to find existing machines that have been upgraded and that could be used for large-scale decontamination operations outdoors. Such machines are in the building industry, the mining industry, and the road construction industry. The road construction industry has yielded the machines in this presentation. A review is given of operations that can be done with the machines available.

17421 (PNL—3700(Pt.5), pp 1) **Regulatory analysis.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

Pacific Northwest Laboratory supported the Regulatory Analysis Division in the review of some proposed radiation protection regulations. However, the principal effort conducted under this part of the program concerned the preparation of a booklet to support a DOE presentation to the people of Bikini Atoll in the Marshall Islands. The Meaning of Radiation at Bikini Atoll describes current radiological conditions resulting from nuclear weapons tests and was drafted in English and translated into Marshallese. (DLS)

17422 (UCRL—53066) **Reassessment of the potential radiological doses for residents resettling Enewetak Atoll.** Robison, W.L.; Phillips, W.A.; Mount, M.E.; Clegg, B.R.; Conrado, C.L. (Lawrence Livermore National Lab., CA (USA)). 30 Oct 1980. Contract W-7405-ENG-48. 97p. NTIS, PC A05/MF A01.

The purpose of this report is to refine the dose predictions, subsequent to the cleanup effort, for alternate living patterns proposed for resettlement of Enewetak Atoll. The most recent data developed from projects at Enewetak and Bikini Atolls for concentration and uptake of Cs, Sr, Pu, and Am were used in conjunction with recent dietary information and current dose models to predict annual dose rates and 30- and 50-y integral doses (dose commitments). The terrestrial food chain in the most significant exposure pathway - it contributes more than 50% of the total dose - and external gamma exposure is the second most significant pathway. Other pathways evaluated are the marine food chain, drinking water, and inhalation.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 16408, 16417, 16576, 16634, 17385, 17543

17423 (BM-RI—8498) **Dewatering of industrial clay wastes.** Smelley, A.G.; Scheiner, B.J.; Zatko, J.R. (Bureau of Mines, Tuscaloosa, AL (USA). Tuscaloosa Research Center). 1980. 16p. Bureau of Mines, Washington, DC.

As a part of research conducted to effect pollution a dewatering technique that allows for disposal of clay wastes, for reuse of water now lost with clays, and for reclamation of mined land was developed. The technique utilizes a high-molecular-weight nonionic polyethylene oxide polymer (PEO) that has the ability to flocculate and dewater materials containing clay wastes. In laboratory experiments, coal-clay waste, potash-clay brine slurry, phosphatic clay waste, uranium tailings, and talc tailings were successfully consolidated. Coal-clay waste was consolidated from 3.6 to 57%; potash-clay brine slurry was consolidated from 3.8 to 35%; phosphatic clay waste from 15.6 to 49%; uranium tailings from 15.4 to 67%; tailings from talc production from 9.7 to 53%; and an acidic TiO_2 slurr slurry from 1.68 to 30%.

17424 (DOE/AD/06212—1) **Site Development Planning Handbook.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Jan 1981. Contract AC01-78AD06212. 74p. NTIS, PC A04/MF A01.

The Handbook provides facility managers and site planners at DOE organizations responsible for planning site developments and facilities utilization a step-by-step planning checklist to ensure that planners at each site are focusing on Department-wide goals and objectives. It begins with a brief discussion of a site development-by-objectives program design to promote, recognize, and implement opportunities for improvements in site utilization through planning. Additional information is included on: assembling existing data, plans, programs, and procedures; establishing realistic objectives; identifying site problems, opportunities; and development needs; determining priorities among development needs; developing short and long-range plans; choosing the right development solutions and meeting minimum legal site restrictions; presenting the plan; implementing elements of the plan; monitoring and reporting plan status; and modifying development program plans. (MCW)

52 ENVIRONMENTAL SCIENCES, AQUATIC

17425 (ORNL/TM—7644) **Guidance for use of experimental systems to evaluate effects of stress in marine ecosystems.** Adams, S.M. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 73p. NTIS, PC A04/MF A01.

Based on a description, review, and evaluation of representative estuarine and marine microecosystems, recommendations and guidance are provided concerning use of these model systems for investigating ecosystem-level responses to stress. Of the three major types of microecosystems that have been used to simulate marine systems, the outdoor flow-through design appears to be the most realistic for investigating ecosystem-level responses to stress.

5201 Basic Studies

REFER ALSO TO CITATION(S) 16686, 17399, 17497, 17555, 17556, 17557

17426 **Light-shade adaptation of Stylophora pistillata, a hermatypic coral from the Gulf of Eilat.** Falkowski, P.G. (Brookhaven National Lab., Upton, NY); Dubinsky, Z. *Nature (London)*; **289**: No. 5794, 172-174(15 Jan 1981).

All reef-forming, or hermatypic, corals harbor photosynthetic endosymbiotic algae called zooxanthellae. The zooxanthellae are essential for the well-being of their hosts; nevertheless, little is known about how light affects the symbiotic association, especially regarding the numbers of zooxanthellae, their photosynthetic responses, and their overall productivity. On the reefs of the Gulf of Eilat, Stylophora pistillata is an abundant hermatypic coral; it is unique in that region in that it can adapt to a wide range of light intensities. In the high light intensities of lagoons or the upper areas of reefs, the corals are markedly lighter in color than those living under ledges, in grottos, or near the reef floor. We report here on the biochemical and physiological adaptations of S. pistillata to variations in light intensity spanning more than two orders of magnitude.

17427 (CONF-791234—, pp 205-214) **Hudson River cleanup.** Henningson, J.C.; Thomas, R.F. (Malcolm Pirnie, Inc., White Plains, NY). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The scope of effort has involved determining the feasibility of removing PCB-contaminated bed material (while minimizing the loss of the contaminant) and placing the material in a secure area until an ultimate destruction method becomes feasible. Such a method must be feasible from both a technical and an economic standpoint. The evaluations were integrated with a number of related studies including extensive sampling of the river system, sedi-

ment sampling, biological sampling, water-quality sampling, laboratory analysis of the various materials, treatability studies, and landfill studies.

17428 **(CONF-810227—2) Alternative geographical display strategies for bivariate relationships.** Waterhouse, J.C.; Farrell, M.P.; Strand, R.H. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From SAS users group international meeting; Lake Buena Vista, FL, USA (8 Feb 1981).

The complexity of regional water management problems necessitates the summarization of water resource data in a form that is easily analyzed visually. Computer generated maps are well suited for displaying complex relationships since they are easy to create and modify and are relatively inexpensive compared to traditional techniques. Development of new display techniques creates questions about the most effective display of data used for generic assessments. Recent attempts at displaying bivariate data geographically have not been entirely successful due to numerous data categories and complex color patterns used in cross mapping techniques. This paper offers an alternate method of displaying bivariate data which uses the degree of differences between two variables (e.g., water supply and water demand) to create a scale in which shades of two primary colors are used for positive and negative differences while a third color is used for the null case (i.e., within the confidence limits of the statistical model.)

17429 **(DOE/EV/00639—22) Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981.** Pomeroy, L.R. (Georgia Univ., Athens (USA). Inst. of Ecology). 1 Feb 1981. Contract AS09-76EV00639. 79p. NTIS, PC A05/MF A01.

There are three distinct areas of research reported, studies of intrusions of the west wall of the Gulf Stream onto the outer continental shelf, studies of the flux of materials across near-shore density fronts, and advances in the understanding of the planktonic food web of the continental shelf. Studies of frontal events on the outer and inner continental shelf involve distinctive physical and chemical regimes and have proven to required distinctive biological approaches. A simulation model of the flux of energy through the continental shelf food web was developed. It represents realistically both details of the energy transfers within the plankton community and the termanal production of fishes. It was discovered that the fecal ribbons of pelagic tunicates break up into flocculent material visually and chemically identical with the flocculent organic aggregates present in sea water. Subsequent experimental work with tunicate fecal matter indicates that some of the naturally occurring aggregates are indeed fecal. This makes it possible to understand and quantify for the first time the production and fate of that population of seston. An examination was made of several of the many roles of dissolved organic compounds in sea water which originate either from release by phytoplankton, digestive processes or metabolites of zooplankton, or extracellular digestion of microorganisms.

17430 **(LBL—12431) Adenosine triphosphate (ATP) in the marine environment: a bibliography.** Jones, A.T.; Hartwig, E.O.; Quinby-Hunt, M.S. (Lawrence Berkeley Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01.

This bibliography lists published works on adenosine triphosphate (ATP) detected in the marine environment. Over 100 citations are listed in four categories: field measurements; macroscopic organisms; benthic populations; and papers on analytical methods.

17431 **(ORNL—5611) Moving boundary storm surge modelling with numerical methods.** Yeh, G.T.; Chou, F.K. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 91p. NTIS, PC A05/MF A01.

This report adopts the time-staggered explicit (TSE) and the alternating-direction implicit (ADI) finite difference techniques to simulate the storm surge on the vertically integrated hydrodynamic equations of continuity and momentum. The unique feature of the present models lies in their treatment of water-land interfaces as moving boundaries (MB). In the present models, the advancing and retreating of the surge wave over the low-lying dry land and the propagation of the water-land interface are dealt with on the basis of physical and mathematical principles. The complete set of governing equations is applied to the water regime as well as the dry land as soon as it is flooded. Numerical experiments indicate that the MB models predict as much as 30% lower surge level at the coastline than the fixed-boundary (FB) models when the adjacent inland area has a mild slope and the wind is very strong. The MB models yield better agreement with recorded surge than the FB models, which consistently overpredict the surge elevations.

17432 **(ORNL/TM—7654) SEAP: a computer program for the error analysis of a stream model, Monte Carlo methodology and program documentation.** Carney, J.H.; Gardner, R.H.; Mankin, J.B.; O'Neill, R.V. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 44p. NTIS, PC A03/MF A01.

The effect of uncertainties in ecological models can be systematically studied by Monte Carlo techniques to obtain the uncertainty of model predictions. The Monte Carlo procedure requires a program which generates random parameter values and obtains numerical solutions. This report documents the general procedures used for the Monte Carlo error analysis of a stream model, along with the computer programs and subroutines that have been developed to simplify this task. An example of the results is provided in the appendices with sufficient information given to adapt the methods to other models.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 16402, 16414, 16416, 16498, 16499, 17329, 17376, 17553

17433 **(ANL/ES—112) Chemistry of bottom sediments from the Cal-Sag channel and the Des Plaines and Illinois Rivers between Joliet and Havana, Illinois.** Harrison, W.; Kucera, E.T.; Tome, C.; Van Loon, L.S.; Van Luik, A. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 62p. NTIS, PC A04/MF A01.

Cores were taken in 28 actual or proposed maintenance-dredging areas. Sixty-one core samples were analyzed to provide a data base for subsequent studies of the suitability of the potential dredged material for reclamation of abandoned surface-mined land bordering the Illinois Waterway. Samples were composited over 2-ft depth increments, up to a maximum 8-ft depth where possible. Parameters determined for each sample were: volatile solids, flash point, polyaromatic hydrocarbons (PAHs), base/neutral organic compounds, pH, total phosphorus, total phenols, oil and grease, polychlorinated biphenyls (PCBs), cyanide, arsenic, barium, cadmium, chromium, copper, lead, mercury, zinc, silver, nickel, selenium, and sulfide. Results showed PCBs to be higher in the Cal-Sag Channel sediments (μ=7.0 mg/kg) than in the Des Plaines River (μ=1.6 mg/kg), or Illinois River (μ=0.5 mg/kg) sediments. Concentrations of metals including arsenic, barium, cadmium, copper, lead, nickel, and silver were higher in the Des Plaines River samples than in the Cal-Sag Channel or Illinois River samples. Illinois River sediments were, generally, the least contaminated in terms of the measured parameters. Leach tests for arsenic, chromium, copper, lead, nickel, and zinc indicated low leachate-metal concentrations relative to total metal concentrations; thus, these metals exist in relatively insoluble solid states in the sediments.

17434 (CONF-791234—, pp 195-204) **Decontamination of water bodies.** Dawson, G.W. (Pacific Northwest Labs., Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

Alternatives for decontamination efforts are reviewed in the context of the physical location of the contaminant after it enters the water body. This defines three scenarios, each of which requires a different approach for mitigation: (1) the contaminant is insoluble and floats on the surface of the water; (2) the contaminant is relatively soluble and mixes into the water column; and (3) the contaminant is insoluble and sinks or has a high affinity for particulate matter residing on the bed of the water body. A review is given of technology available to address each of these possibilities

reflecting both the state-of-the-art and practical experience gained in actual cleanup efforts.

17435 **(ORNL—5602) AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system.** Yeh, G.T. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 90p. NTIS, PC E04/MF $3.50.

Includes 1 sheet of 48x reduction microfiche.

A generalized analytical transient, one-, two-, and/or three-dimensional (AT123D) computer code is developed for estimating the transport of wastes in a groundwater aquifer system. It contains 450 options: 288 for the three-dimensional case, 72 for the two-dimensional case in the x-y plane, 73 for the two-dimensional case in the x-z plane, and 18 for the one-dimensional case in the longitudinal direction. These are the combinations of three types of wastes, eight sets of source configurations, three kinds of source releases, and four variations of the aquifer dimensions. Three types of the wastes are radioactive waste, chemicals, and heat. The eight types of source configurations are a point source, a line source parallel to the x-axis, a line source parallel to the y-axis, a line source parallel to the z-axis, an area source perpendicular to the x-axis, an area source perpendicular to the y-axis, an area source perpendicular to the z-axis, and a volume source. Three kinds of source releases are instantaneous, continuous, and finite duration releases. Four variations of the aquifer dimensions are finite depth and finite width, finite depth and infinite width, infinite depth and finite width, and infinite depth and infinite width. The mechanisms of transport included in the analysis are advection, hydrodynamic dispersion, adsorption, decay/degeneration, and waste losses to the atmosphere. Boundary conditions included Dirichlet, Neumann, mixed type, and/or radiation boundaries. Fifty sample cases are provided to illustrate the application of AT1230 to various situations.

17436 **(PB—80-216757) Effects of underground coal mining on ground water in the eastern United States. Final report, September 1976-September 1979.** Sgambat, J.P.; LaBella, E.A.; Roebuck, S. (Geraghty and Miller, Inc., Annapolis, MD (USA)). Jun 1980. Contract EPA-68-03-2467. 201p. NTIS, PC A10/MF A01.

This report addresses the past effects and the possible future effects of underground coal mining activities on ground-water resources in the region east of the 100th meridian. Such effects are highly dependent on the location of the mine with respect to natural flow system. Recharge-discharge relationships in the vicinity of active mines may be altered, and lowered ground-water levels may not recover to pre-mining conditions after closure. Studies indicate that contamination of ground water exists in many places in the immediate vicinity of coal mines. Many refuse piles and impoundments likely affect stream and shallow ground-water quality. From the viewpoint of the value of ground-water resources, it is most likely that future underground mining in the Eastern Interior Basin and the southern Appalachians will result in adverse ground-water effects in only very limited areas.

17437 **(PB—80-814809) Oil spill removal techniques and equipment. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Aug 1980. 115p. NTIS PC N01/MF N01.

The removal processes cover oil water separators, skimmers, dispersants, adsorbents, flotation and combustion. Related studies on oil spreading, droplet entrainment, prototype removal systems, equipment and costs are also presented. Oil water separators designed only for tanker ballast water cleaning are excluded. (This updated bibliography contains 131 citations, 21 of which are new entries to the previous edition.)

17438 (PNL—3700(Pt.5), pp 25-28) **Oil spills.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The objective of a field test on the combustibility of various crude oils was to determine their burning rates, the requirements for igniting them, and the conditions under which combustion will occur. Several representative crude oils were tested. The test shows that, under optimal conditions, the major portion of an oil spill can be burned, leaving a residue that is more easily removed and smaller in volume than the crude oil itself. Most crude oils will burn successfully if significant weathering has not occurred. The study of fuel conservation by the application of spill prevention and failsafe engineering resulted in the development of a guideline manual for use by plant engineers and managers, Federal employees, and insurance and fire prevention inspectors. Nationwide surveys of plants clearly indicated the need for the publication which, when used to advantage, should reduce the annual loss of hydrocarbon products from accidental discharges. Special emphasis is placed on plant security in an effort to reduce the number of spills experienced annually from theft, malicious mischief, and plant sabotage.

17439 **Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb.** Cushing, C.E. Jr.; Thomas, J.M. (Battelle-Pacific Northwest Labs., Richland, WA). Contract EY-76-C-06-1830. *Ecology ;* **61**: No. 6, 1321-1326(Dec 1980).

Two macrophytes, Myriophyllum heterophyllum and Potamogeton richardsonii, and sediments were transplanted (1) from a site with low trace metal concentrations in the sediments to one with higher levels, and (2) from the site with high concentrations to artificial ponds containing sediments with lower concentrations to assess the uptake and retention processes for Cu and Zn. Uptake of Cu and Zn by the sediments was extremely slow over the 100-d study; only the slope of the uptake of Zn in the upper 5 cm was significantly $> 0 (P < .01)$. Nonlinear least squares fits of P. richardsonii and M. heterophyllum data to mathematical models revealed that predicted concentrations and measured uptake values were in good agreement. Uptake and retention half-times averaged 3.7 and 6.7 d, respectively, and showed little difference between plant species or trace metals. Calculated ratios lead us to speculate that known levels of Cu and Zn in one plant species may be useful in estimating concentrations in the other. The data suggest that roots, rather than shoots, are the predominant site of uptake for Cu and Zn in these species.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 16578, 17402, 17421, 17435

17440 **(DP—1592) Transuranics in a stream near a nuclear-fuel chemical separations plant.** Holloway, R.W.; Hayes, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1981. Contract AC09-76SR00001. 18p. NTIS, PC A02/MF A01.

The concentrations of plutonium, americium, and curium in a small stream that drains the chemical separations areas on the Savannah River Plant were determined. Typical concentrations for ^{238}Pu, $^{239,240}Pu$, ^{241}Am, and ^{244}Cm were 39, 9.5, 5.0, and 7.5 fCi/L, respectively. These concentrations are much lower than the maximum permissible concentrations in water of 30 nCi/L (US Code of Federal Regulations, 10 CFR-20). Less than half of all transuranic activity was associated with particles that were one micron or greater in diameter. The distribution coefficients for plutonium, americium, and curium were 2.9×10^5, 6.1×10^5, and 8.3×10^5, respectively. The plutonium distribution coefficient is similar to that measured in Lake Michigan.

17441 **(MLM—2822) Annual environmental monitoring report: Calendar Year 1980.** Farmer, B.M.; Carfagno, D.G. (Mound Facility, Miamisburg, OH (USA)). 24 Apr 1981. Contract AC04-76DP00053. 50p. NTIS, PC A03/MF A01.

The local environment surrounding Mound Facility was monitored primarily for tritium and plutonium-238. The results are reported for CY-1980. The environmental media analyzed included air, water, vegetation, foodstuffs, and sediment. The average concentrations of plutonium-238 and tritium were within the applicable standards for radioactive species.

17442 **(SAND—80-2573) Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas.** Kupferman, S.L.; Moore, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 28p. (CONF-800420—6). NTIS, PC A03/MF A01.

From 2. international ocean disposal symposium; Woods Hole, MA, USA (15 Apr 1980).

Scenarios which follow the development in space and time of the concentration field of a dissolved tracer released at the sea floor are presented for a Pacific and two Atlantic study areas. The scenarios are closely tied to available data by means of simple analytical models and proceed in stages from short time and space scales in the immediate vicinity of a release point to those scales characteristic of ocean basins. The concepts of internal mixing time and residence time in the benthic mixed layer, useful for developing an intuitive feeling for the behavior of a tracer in this feature, are introduced and discussed. We also introduce the concept of domain of occupation, which is useful in drawing distinctions between mixing and stirring in the ocean. From this study it is apparent that reliable estimation of mixing will require careful consideration of the dynamics of the eddy fields in the ocean. Another area in which more information is urgently needed is in the relation of deep isopycnal structure and bottom topography to local near-bottom circulation.

17443 **Increased cesium uptake by water tupelo under inundated conditions.** McLeod, K.W. (Savannah River Ecology Lab., Aiken, SC (USA)). *Health Physics ;* **39**: No. 5, 809-812(Nov 1980).

Low level releases of ^{137}Cs to streams has resulted in concentrations greater than background levels in soils, sediments and plants of the Savannah River swamp. The object of this study was to determine the effect of inundation on the absorption of ^{137}Cs by water tupelo (Nyssa aquatica) which is dominant in the swamp and is able to survive and grow well under flooded conditions. Results show that actively growing young water tupelo absorb about twice as much ^{137}Cs when grown in the laboratory under inundated conditions suggesting that in the spring, when inundated conditions usually exist and rapid growth occurs, uptake of ^{137}Cs is high. Some Cs is transported from soil depths and returned to soil surface via incorporation into leaves and subsequent leaf fall, thus continually mixing Cs which was buried below the soil surface.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 17435

17444 **Thermal ecology: environmental teachings of a nuclear reactor site.** Gibbons, J.W.; Sharitz, R.R. (Univ. of Georgia, Aiken, SC). Contract EY-76-C-0819. *Bioscience ;* **31**: No. 4, 293-298(Apr 1981).

The Savannah River Plant in South Carolina provides unique opportunities to study long-term environmental sequences of temperature increases in aquatic habitats. Although the temperatures are elevated by effluents from nuclear production reactors, principles of thermal ecology can be derived that are applicable to many natural, as well as men-modified, environments.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 16415, 16500, 17385, 17523

17445 **(SAND—81-0210) Gases in the marine sedimentary environment: causes and effects.** Grube, K.K. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01.

Technological advancements combined with society's ever increasing energy demands have made exploration of the world's oceans both feasible and attractive. Because many of the engineering applications involve interactions with the sea floor, it follows that the characteristics of the seafloor sediments are of primary concern. One type of soil which presents special problems is sediment laden with gas. The following research investigates gases in the marine sedimentary - first, looking at the origins of these gases and the states in which they exist; second, reviewing the various techniques used for detecting the presence of gases; and, third, examining the impact of gases on sediment properties.

5206 Regulations

REFER ALSO TO CITATION(S) 16917

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

17446 (PNL—3700(Pt.5), pp 61) **Environmental data reporting system.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

A draft interim report on the content and routing of existing environmental data reporting was prepared, including a discussion of alternative approaches to use of a computerized data base and recommendations for further efforts.

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 16503, 16504, 16653, 16933, 17377, 17422

17447 **(ANL/AA—24) Labor productivity in heavy construction: impact on synfuels program employment.** Kusterer, K.C. (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 44p. NTIS, PC A03/MF A01.

This study focuses on variations in labor productivity in the heavy construction industry. Productivity is one of a number of factors likely to affect the speed and cost of constructing a synthetic fuels plant. The findings of this study are presented with reference to synthetic fuels plants, but they are relevant to other large energy facilities as well. The data were gathered through a detailed literature search and extensive in-depth interviews with consultants in heavy industrial construction, union officials, and management. In this manner the most important determinants of labor productivity were identified and ranked in terms of relative significance. The type of project under construction is the most important factor affecting the productivity of heavy construction labor. Projects characterized by the utility work syndrome are large, complex, relatively unique, highly regulated, and have cost-plus contracts and tight deadlines. Such projects generally have lower-than-average levels of labor productivity. Labor productivity is also lowered by worker and management morale problems, due to delays and design changes, and by high levels of unemployment among construction workers. Finally, boom town conditions, caused by workers moving to live near large projects located in rural areas, also are likely to result in below-average labor productivity.Synthetic fuels plants are likely to have a number of these identified characteristics. Consequently, the findings suggest that labor productivity may well be a problem for the timely development of an economically competitive synthetic fuels industry.

17448 **(DOE/EV/10281—T3) Climate change and society: consequences of increasing atmospheric carbon dioxide.** Kellogg, W.W.; Schware, R. (Aspen Inst. for Humanistic Studies, CO (USA)). 1981. Contract AC02-79EV10281. 192p. NTIS, PC A09/MF A01.

This book summarizes current knowledge of the causes of climatic change and presents a scenario of the future climate distribution that could prevail on a warmer Earth. It then focuses on the impacts of climatic change - in particular, a global warming accompanied by a shift in rainfall patterns - in such vital areas as food and fiber production, water resources, natural ecological systems, fisheries, health and disease, energy demand, and so forth. The authors discuss in detail the political, economic, social, and ethical implications of global environmental change. They also evaluate national and international strategies for mitigating the impacts of climatic change or possibly averting that change altogether.

17449 (TR—80/031-001, pp 287-297) **Socioeconomic issues associated with the use of peat as an energy resource.** Harner, D.D. (Radian Corp., Austin, TX). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

Use of peat as an energy resource will cause socioeconomic issues to emerge, regardless of where it is harvested or the size of the development. And while peat use is different in many ways, the socioeconomic issues we have identified are very similar to those for surface mining of coal and the construction and operation of power plants. Growth management techniques have been designed to deal with these issues and many will be transferable to peat developments. Sensible modifications to existing services/facilities can help overcome potential problems and create new industries at the same time.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 16577, 17388, 17420

17450 (CONF-791234—, pp 167-170) **Project planning approach.** Toomey, J.E. (Rockwell Hanford Operations, Richland, WA). Feb 1981.

From Environmental decontamination workshop; Oak Ridge, TN, USA (4 Dec 1979).

The project planning approach utilized by Rockwell Hanford Operations in outdoor cleanup activities is discussed. The discussion addresses the rationale and requirements, as well as a description of the planning documents. In addition, a recommended adaptation of this approach toN a large-scale environmental cleanup process is described.

17451 **(CONF-800567—6) Comparative health and safety assessment of alternative future electrical-generation systems.** Habegger, L.J.; Gasper, J.R.; Brown, C.D. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01.

From International symposia alternative energy sources and technology; Montreal, Canada (28 May 1980).

The report is an analysis of health and safety risks of seven alternative electrical generation systems, all of which have potential for commercial availability in the post-2000 timeframe. The systems are compared on the basis of expected public and occupational deaths and lost workdays per year associated with 1000 MWe average unit generation. Risks and their uncertainties are estimated for all phases of the energy production cycle, including fuel and raw material extraction and processing, direct and indirect component manufacture, on-site construction, and system operation and maintenance. Also discussed is the potential significance of related major health and safety issues that remain largely unquantifiable. The technologies include: the SPS; a low-Btu coal gasification system with an open-cycle gas turbine combined with a steam topping cycle (CG/CC); a light water fission reactor system without fuel reprocessing (LWR); a liquid metal fast breeder fission reactor system (LMFBR); a central station terrestrial photovoltaic system (CTPV); and a first generation fusion system with magnetic confinement. For comparison with the baseload technologies, risk from a decentralized roof-top photovoltaic system with 6 kWe peak capacity and battery storage (DTPV) was also evaluated.

17452 **(LMF—82) Potential health and environmental effects of diesel light duty vehicles.** Cuddihy, R.G.; Seiler, F.A.; Griffith, W.C.; Scott, B.R.; McClellan, R.O. (Inhalation Toxicology Research Inst., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76EV01013. 68p. NTIS, PC A04/MF A01.

Quantitative projections of changes that could occur in the levels of environmental pollutants and in the risks to human health as a result of light duty diesel vehicles are similar to risks for using gasoline engine vehicles. This assessment uses current scientific information to identify new directions for DOE research programs. It includes the manufacture and service of products and facilities that are necessary to support the use of light duty diesel vehicles in the US. Socio-economic factors are included. (PSB)

17453 (PNL—3700(Pt.5), pp 3-9) **Technology assessment.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

Pacific Northwest Laboratory's work in Technology Assessment covers a variety of energy technologies. PNL contributed to the formulation of Environmental Development Plans on coal liquefaction and coal gasification and Environmental Readiness, and documents for magnetic fusion and Advanced Isotope Separation. Also included in PNL work are technology assessments for enhanced oil recovery, unconventional gas recovery, oil-shale industry, in-situ uranium mining, magnetic fusion energy, uranium enrichment, and solar energy, and finally Industrial Energy Utilization. (DLS)

17454 (PNL—3700(Pt.5), pp 21-23) **Liquefied natural gas (LNG) safety studies.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The objectives of this project are: (1) to conduct research and development in specific areas of the DOE Liquefied Gaseous Fuels (LGF) Safety and Environmental Control Assessment Program; and (2) to provide assistance to the DOE/EV Environmental and Safety Engineering Division in the planning and technical surveillance of the Program. Several tasks and milestone reports were completed in FY 1980, including reports on the LNG facility scoping assessment, a detailed assessment of release prevention systems in LNG import terminals, human factors engineering, and LNG storing tanks. In the Ammonia Assessment Task, studies were conducted on potential future applications of ammonia as an energy material and the trace ecological effects resulting from increased ammonia usage. Literature surveillance and the development of an LNG library continued. Assistance was provided in the preparation of the Second Status Report (DOE/EV-0085) on progress in the LGF Assessment Program. Five PNL project reports were published by the DOE in this status report. In addition, a survey of foreign experience in the use of LNG as an automotive fuel was performed and a video tape was completed showing selected LNG wind tunnel simulation runs conducted at Colorado State University.

17455 (PNL—3700(Pt.5), pp 29-30) **Liquefied petroleum gas (LPG) research assessment.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The project's objective is to evaluate safety and environmental control issues relating to the processing, transportation, storage, and use of liquefied petroleum gas (LPG). The resulting information will support the DOE/EV Environmental and Safety Engineering Division in developing an LPG research and development plan as part of the DOE Liquefied Gaseous Fuels (LGF) Safety and Environmental Control Assessment Program. Information provided by PNL and its subcontractors was compiled and edited into a preliminary report describing the LPG industry and its principal facilities and systems. Over twenty assessments were prepared that identify R and D needs resulting from LPG safety and environmental control concerns. A state-of-the-art review of LPG release prevention and control was contributed to the LGF Assessment Program Second Status Report.

17456 (PNL—3700(Pt.5), pp 31-33) **Environmental control technology for shale oil wastewaters.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The capabilities and limitations of conventional treatment and disposal technology are being evaluated for shale oil wastewaters. Laboratory studies (bench-scale) are being conducted to assess the effectiveness of several physical, chemical, and biological processes for removing pollutants from shale oil wastewaters. Preliminary cost estimates based on bench-scale studies ranged from $11 to $25/1000 gal of in-situ retort water treated by sedimentation, steam stripping, biologically activated carbon, chemical coagulation and filtration, and activated sludge. Bench-scale studies on evapora-

tion of in-situ retort water indicate that a higher quality effluent can be produced at a lower cost ($7/1000 gal) using this process rather than the series of processes given above. The condensate produced by evaporation has very low concentrations of inorganic constituents, including arsenic and other heavy metals, and can be readily treated to remove organic residuals.

17457 (PNL—3700(Pt.5), pp 35-36) **Geothermal liquid waste disposal.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

Three disposal techniques are being used at geothermal sites around the world: direct discharge to surface waters, deep-well injection, and ponding. Several other techniques are considered viable options. Additional research and development are needed to reduce the uncertainties and to minimize the potential adverse environmental impacts of disposal.

17458 (PNL—3700(Pt.5), pp 37) **Compressed air energy storage (CAES).** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The objectives of this project are to identify potential environmental problem areas associated with the implementation of Compressed Air Energy Storage (CAES) technology, to assess the potential impacts of these concerns, and to identify or highlight the need for technologies to prevent or control adverse impacts. Research efforts in FY 1980 consisted primarily of preliminary assessments of probable subsurface effects such as alteration of hydrological and geochemical conditions, geologic phenomena, and initiation of an assessment of the legal and regulatory issues associated with CAES technology.

17459 (PNL—3700(Pt.5), pp 39-43) **Analysis of nuclear fuel cycles.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The environmental control implications of continuing to develop existing nuclear fuel cycles and implementing new fuel cycles are systematically determined so technologies that control or eliminate the discharge of noxious materials can be developed and demonstrated. The objective of this program is to identify areas in developing nuclear fuel cycles where inadequate consideration is being given to environmental controls and areas where environmental control improvements can be justified on a cost/risk/benefit basis. Included are overviews of Gas-Cooled Fast Breeder Reactor, Light Water Reactor Improvements, and Liquid Metal Fast Breeder Reactors, and an overview of Thorium/Uranium Environmental Control Technology. (DLS)

17460 (PNL—3700(Pt.5), pp 45-48) **Analysis of fusion fuel cycles.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The objective of this task is to undertake an independent review and analysis of current fusion facilities that have or will generate tritium wastes and effluents to the environment. Consideration is given to those fusion facilities that are in operation or under construction. These include the magnetic fusion facilities: Tokamak Fusion Test Reactor (TFTR), the Tritium Systems Test Assembly (TSTA), and the Fusion Materials Irradiation Test Facility (FMIT). Facilities in the Inertial Confinement Fusion area will also be reviewed and analyses made of the tritium control problems. Based on these analyses, experimental data needs to support the environmental control technology of fusion facilities will be evaluated.

17461 (PNL—3700(Pt.5), pp 53-55) **DOE decommissioning criteria development.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

A working draft of the Radiological Guide for DOE Decommissioning Operations prepared by PNL is discussed. Included are listings of basic radiation standards, recommendations for site characterization, methods for estimating occupational radiation exposures, and recommendations for generating and maintaining records for quality assurance procedures. (DLS)

17462 (PNL—3700(Pt.5), pp 57) **Environmental protection support.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

Assurance in planning was provided for a Department of Energy (DOE) and contractor staff information meeting in early FY 1981 in compliance with the Resource Conservation and Recovery Act. A questionnaire to clarify the extent and content of quality assurance provisions in effluent and environmental monitoring programs was prepared and distributed to DOE sites as part of an emergency preparedness questionnaire distributed under another project. A draft section on quality assurance was provided for possible inclusion in a revised DOE Orders chapter. A review of available documentation for DOE sites on the methodology used to calculate environmental dose was partially completed, and a questionnaire for possible site distribution was drafted. A questionnaire to DOE sites to determine existing inventories of nonradiological materials in waste storage sites was prepared.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 17500, 17529

17463 **Potential effects of energy related activities on the seasonal trajectories of epiphytic marine diatoms.** Coccetti, G.F.; Lee, J.J. (City Univ. of New York, NY). Contract E(11-1)3254. *Hydrobiologia ;* 67: No. 1, 51-80(1979).

Seasonal successional trajectories of transplanted and experimental diatom communities were studied during the summer of 1973. Manipulation of these diatom assemblages was accomplished through the development of an in situ experimental apparatus capable of incubating these organisms without doing violence to the community itself. In one set of experiments the effects of water equality were tested on the development of inocula from grossly similar but fairly distant locations. In another set the native inoculum was incubated in the continual presence of Fe, Cu, Cr, Pb, Sn, and crude oil. Seasonal succession took place in all of the control and experimental communities. During the course of succession the trajectories of assemblages under some conditions converged while others diverged. Since the random fluctuations in the environment were constant for all assemblages, the abundances of individual species were due to niche packing and interspecific restraints on the biotic potential of selected diatom species as well as the change in water quality. The most diverse community was an experimentally mixed one. The high diversity of this community was probably due to niche packing a phenomenon which restricted the realized niches of many species and hindered their blooming. Paradoxically twice as many species (40%) had their greatest niche breadth in the mixed community as did species in the transplanted (~ 20%) or native controls (17%). Enrichment of the incubation medium with heavy metals and oil altered the community structure and diversity of most experimental vessels. Growth of some species were depressed while that of others was exhausted.

17464 **Epidemiological investigations concerning affective disorders.** Helgason, T. (Univ. of Iceland, Reykjavik). pp 241-255 of Prevention and treatment of affective disorders. Schou, M.; Stroemgren, E. (eds.). London, England; Academic Press (1979).

Numerous epidemiological studies have demonstrated that mental disorders occur with great frequency in the general population. Many of these studies concern affective disorders, which constitute a large proportion of the mental disorders. They have shown that affective, or manic-depressive, psychosis occurs with much greater frequency than previously thought. Population surveys and studies from outpatient clinics, which are easily accessible and offer

free services, have shown that there is a great number of mild cases and/or episodes of affective disorders which do not otherwise come to attention.

5502 Biochemistry

REFER ALSO TO CITATION(S) 16639, 17487, 17488, 17498, 17499, 17502, 17520, 17530, 17540, 17559

17465 **(DOE/ER/02755—5) Fundamental study of the mechanism and kinetics of cellulose hydrolysis by acids and enzymes. Final report, June 1, 1978-January 31, 1981.** Gong, C.S.; Chang, M. (Purdue Univ., Lafayette, IN (USA). Lab. of Renewable Resources Engineering). Feb 1981. Contract AS02-76ER02755. 172p. NTIS, PC A08/MF A01.

There are three basic enzymes [e.g., endoglucanase (C/sub x/), exoglucanase (C_1) and cellobiase] comprising the majority of extracellular cellulase enzymes produced by the cellulolytic mycelial fungi, Trichoderma reesei, and other cellulolytic microorganisms. The enzymes exhibited different mode of actions in respect to the hydrolysis of cellulose and cellulose derived oligosaccharides. In combination, these enzymes complimented each other to hydrolyze cellulose to its basic constituent, glucose. The kinetics of cellobiase were developed on the basis of applying the pseudo-steady state assumption to hydrolyze cellobiose to glucose. The results indicated that cellobiase was subjected to end-product inhibition by glucose. The kinetic modeling of exoglucanase (C_1) with respect to cellodextrins was studied. Both glucose and cellobiose were found to be inhibitors of this enzyme with cellobiose being a stronger inhibitor than glucose. Similarly, endoglucanase (C/sub x/) is subject to end-product inhibition by glucose. Crystallinity of the cellulose affects the rate of hydrolysis by cellulases. Hence, the changes in crystallinity of cellulose in relation to chemical pretreatment and enzyme hydrolysis was compared. The study of cellulase biosynthesis resulted in the conclusion that exo- and endo-glucanases are co-induced while cellobiase is synthesized independent of the other two enzymes. The multiplicity of cellulase enzymes are the end results of post-translational modification during and/or after the secretion of enzymes into growth environment.

17466 **(DOE/ER/04927—T1) Direct observation of electron transfer across a lipid bilayer: laser photolysis of an asymmetric vesicle system containing chlorophyll, methyl viologen, and EDTA.** Ford, W.E.; Tollin, G. (Arizona Univ., Tucson (USA)). 1980. Contract AS02-78ER04927. 14p. NTIS, PC A02/MF A01.

Electron transfer across lipid bilayer vesicle walls was examined by laser flash photolysis to determine the mechanisms of charge transport across the membrane. The discussion is restricted to vesicles whose walls contain phosphatidylcholine, chlorophyll a, and valinomycin. (ACR)

17467 **(DOE/ER/04927—T2) Mechanisms of photochemical energy conversion by chlorophyll. Progress report, April 1, 1980-March 30, 1981.** Tollin, G. (Arizona Univ., Tucson (USA). Dept. of Biochemistry). 1981. Contract AS02-78ER04927. 9p. NTIS, PC A02/MF A01.

The results presented demonstrate that important progress has been made towards defining the elementary processes involved in chlorophyll one-electron transfer reactions. Considerable insight was obtained into how these can be made more efficient and how energy-wasting back reactions can be minimized. An understanding of the mechanisms involved in the coupling of these reactions in more complex systems to obtain a vectorial storage of energy across an insulating barrier (i.e. a lipid bilayer) is developing. The information must ultimately prove useful in the long-range goal of developing practical means of solar energy utilization. (ERB)

17468 **(DOE/ER/04927—T3) Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay.** Hurley, J.K.; Tollin, G. (Arizona Univ., Tucson (USA)). 1980. Contract AS02-78ER04927. 32p. NTIS, PC A03/MF A01.

Laser flash photolysis has been used to investigate the mechanism of formation and decay of the radical species generated by light induced electron transfer from chlorophyll a triplet to quinone in egg phosphatidyl choline bilayer vesicles. Chlorophyll triplet quenching by quinone is controlled by diffusion occurring within the bilayer membrane and reflects bilayer viscosity. Radical formation via separation of the intermediate ion pair is also inhibited by increased bilayer viscosity. Cooperativity is observed in this process due to an enhancement of radical separation by electron transfer from semiquinone anion radical to a neighboring quinone molecule. Two modes of radical decay are observed, a rapid recombination occurring within the bilayer and a much slower recombination occurring across the bilayer. The slow decay is only observed with quinones which are not tightly anchored into the bilayer, and is probably the result of electron transfer from semiquinone anion radical formed within the bilayer to a quinone molecule residing at the bilayer-water interface. With benzoquinone, approximately 60% of the radical decay occurs via the slow mode. Triplet to radical conversion efficiencies in the bilayer systems are comparable to those obtained in fluid solution (~ 60%). However, radical recombination, at least for the slow decay mechanism, is considerably retarded.

17469 **(DOE/EV/03017—T1) Tissue enzyme changes in parabiotic rats with subcutaneous lymphoma.** Herzfeld, A.; Greengard, O.; Warren, S. (New England Deaconess Hospital, Boston, MA (USA). Cancer Research Inst.; Harvard Medical School, Boston, MA (USA). Dept. of Biological Chemistry). 1977. Contract AS02-76EV03017. 15p. NTIS, PC A02/MF A01.

A solid lymphoma was implanted into normal rats and into one partner of parabiotic pairs. Appreciable decreases in hepatic ornithine aminotransferase and arginase occurred about a week earlier (4 to 6 days after implantation) in single than in parabiotic hosts. By 18 to 21 days significant decreases in both enzymes were also apparent in the host partner. The hepatic thymidine kinase showed a 5-fold elevation in single hosts 4 days after implantation; by 14 days its levels were about 200 times above normal and had also risen in the parabiotic hosts (20-fold) and the host partners (4-fold). Implantation of fibrosarcoma caused qualitatively similar but generally less pronounced changes in the above 3 enzymes in livers of single hosts, parabiotic hosts, and host partners. The splenic thymidine kinase, 14 days after implantation, was increased from control levels of about 3 units/g to 50.6, 44.8, and 13.5 units/g in single hosts, parabiotic hosts, and host partners, respectively. At later stages, 17 to 20 days after implantation of the lymphoma, appreciable amounts of thymidine kinase appeared in the plasma: the units of activity per ml were 6.2 in single hosts, 0.79 in parabolic hosts, and 0.55 in host partners (control <0.05). The observations on the hepatic and splenic enzyme changes in parabiotic rats suggest that effects of neoplasms on distant host tissues are mediated by humoral factors. The less pronounced responses in parabiotic than in single hosts indicate that the tumor-free partner affords some protection against these systemic effects.

17470 **Electron transport across glycerol monooleate bilayer lipid membranes facilitated by magnesium etiochlorin.** Feldberg, S.W. (Brookhaven National Lab., Upton, NY); Armen, G.H.; Bell, J.A.; Chang, C.K.; Wang, C.B. Contract DE-AC02-76CH00016. *Biophysical Journal ;* **34**: No. 1, 149-163(Apr 1981).

The system described here comprises a glycerol monooleate bilayer lipid membrane (blm) containing a magnesium etiochlorin (Mg-C) separating two aqueous phases each containing ferricyanide, ferrocyanide, KCl, and a platinum electrode. The E^0s for the $Mg\text{-}C^+/Mg\text{-}C$ and ferri-/ferrocyanide couples are 0.22 and 0.24 V vs. SCE. Thus the $Mg\text{-}C^+/Mg\text{-}C$ system is easily poised by the ferri-/ferrocyanide system. When the potentials of the ferri-/ferrocyanide couples are different on each side of the blm we show that the open-circuit membrane potential nearly equals the difference between the redox potentials. This is unequivocal evidence that electrons are being transferred across the blm from one aqueous phase to the other. On the basis of these experiments we deduce that electron transport is the major charge transport mechanism. When redox potentials are the same on each side of the blm, the conductance of the membrane can be $> 10^{-3}$ S/cm^2. The conductance is proportional to the second power of the concentration of Mg-C in the membrane-forming mixture. A number of additional experiments are described which attempt to elucidate the mechanism of

electron transfer. The data are consistent with the idea of an electron-hopping mechanism in which the transmembrane electron transport occurs by a series of second-order electron transfers between membrane-bound electron donors (Mg-C) and acceptors ($Mg\text{-}C^+$). Alternative explanations are presented.

17471 **Chronotypic induction of tyrosine aminotransferase by α-methyl-p-tyrosine.** Cahill, A.L.; Ferguson, S.M.; Ehret, C.F. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Life Sciences ;* **28**: No. 14, 1665-1671(6 Apr 1981).

αMethyl-p-tyrosine induced hepatic tyrosine aminotransferase activity to different extents depending upon the time of day of administration of the drug. Maximal induction occurred when α-methyl-p-tyrosine (100 mg/kg) was injected intraperitoneally during the first several hours of the light phase of the daily cycle, but the magnitude of the induction depended on the nutritional state of the animal. Induction was 4- to 5-fold greater in fasting rats. The effect of α-methyl-ptyrosine on hepatic tyrosine aminotransferase is believed to be mediated by decreases in hypothalamic norepinephrine. This hypothesis was supported by the demonstration that decreasing levels of hypothalamic norepinephrine at times of day when hypothalamic turnover of norepinephrine was greatest resulted in the greatest induction of tyrosine aminotransferase, while lowering hypothalamic norepinephrine at times when turnover was minimal resulted in minimal induction of tyrosine aminotransferase.

17472 **Deoxyribonuclease I in mammalian tissues.** Lacks, S.A. (Brookhaven National Lab., Upton, NY). *Journal of Biological Chemistry, The ;* **256**: No. 6, 2644-2648(25 Mar 1981).

Enzymes of the DNase I class, similar to bovine pancreatic DNase I with respect to molecular weight and ionic and pH requirements, were found in various tissues of the rat. Their analysis was facilitated by a method for detection of nucleases in crude extracts after polyacrylamide gel electrophoresis in the presence of sodium dodecyl sulfate and subsequent renaturation of the enzymes. High levels of DNase I were found in digestive tissues, such as the parotid and submaxillary salivary glands and the lining of the small intestine. Appreciable levels were present in the lymph node, kidney, heart, prostate gland, and seminal vesicle. No activity was found in pancreatic extracts. However, under some conditions, tissues rich in proteases gave poor recovery of DNase I. Fourteen other tissues showed little or no DNase I. Inhibition of various DNase I enzymes by rabbit muscle actin was examined both in gels and in solution. Actin inhibited the bovine parotid DNase I as well as the bovine pancreatic enzyme, but actin did not inhibit any of the DNase I enzymes of the rat. This species specificity of actin inhibition makes it unlikely that the very strong association between monomeric actin and bovine DNase I is of general significance for cellular function.

17473 **Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding.** MacLeod, M.C. (Oak Ridge National Lab., TN); Kootstra, A.; Mansfield, B.K.; Slaga, T.J.; Selkirk, J.K. Contract W-7405-ENG-26. *Proceedings of the National Academy of Sciences of the United States of America ;* **77**: No. 11, 6396-6400(Nov 1980).

Benzo[a]pyrene (B[a]P), 7,8-dihydroxy-7,8-dihydro-B[a]P, and 9,10-dihydroxy-9,10-dihydro-B[a]P are metabolized by hamster embryo cells to derivatives that bind to nuclear macromolecules. The selectivity for different classes of macromolecules varies depending on the compound analyzed. The ratio of DNA specific activity to protein specific activity (pmol bound/mg of macromolecules) is high (1.51) for 7,8-dihydroxy-7,8-dihydro-B[a]P, extremely low (0.03) for 9,10-dihydroxy-9,10-dihydro-B[a]P, and intermediate (0.26) for B[a]P. Histones H3 and H2A are the major targets of 7,8-dihydroxy-7,8-dihydro-B[a]P; a protein(s) with a mobility similar to that of histone H1 is heavily labeled by 9,10 dihydroxy-9,10-dihydro-B[a]P, with minor labeling of other (nonhistone) bands. The labeling pattern seen with B[a]P is a combination of the patterns seen with the two dihydrodiol metabolites studied. Analysis of the ethyl acetate-soluble metabolites suggests that hamster embryo cells produce 9,10-dihydroxy-7,8-oxy-7,8,9,10-tetrahydro-B[a]P from 9,10-dihydroxy-9,10-dihydro-B[a]P and raise the possibility that this vicinal diol epoxide is an intermediate in the binding of 9,10-dihydroxy-9,10-dihydro-B[a]P to nuclear proteins. The differences seen suggest that factors other than the intrinsic chemical reactivity of the epoxide group are extremely important in the ineraction of potential ultimate carcinogens with biological systems.

17474 **Regulatory coupling of nitrate and sulfate assimilation pathways in cultured tobacco cells.** Reuveny, Z. (W. Alton Jones Cell Science Center, Lake Placid, NY); Dougall, D.K.; Trinity, P.M. *Proceedings of the National Academy of Sciences of the United States of America ;* **77**: No. 11, 6670-6672(Nov 1980).

When cultured tobacco cells are provided growth-limiting concentrations of sulfur as sulfate, the rate of development of nitrate reductase (NADH:nitrate oxidoreductase, EC 1.6.6.1) is proportional to the initial sulfate concentration. When the cells are provided growth-limiting concentrations of nitrogen as nitrate, the rate of derepression of ATP sulfurylase (ATP:sulfate adenylyltransferase, EC 2.7.7.4) is proportional to the initial nitrate concentration. These results are taken to be indicative of a reciprocal regulatory coupling between the nitrate and sulfate assimilation pathways.

17475 **Synaptonemal complexes at premeiotic interphase in the mouse spermatocyte.** Grell, R.F.; Oakberg, E.F.; Generoso, E.E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Proceedings of the National Academy of Sciences of the United States of America ;* **77**: No. 11, 6720-6723(Nov 1980).

Male mice were injected intraperitoneally with 125 μCi(1 Ci = 3.7 x 10^{10} becquerels) of [^{3}H]thymidine at 1-h intervals and killed 1 h after the second injection. Testes were prepared for bright-field and electron microscopic autoradiography. Primary spermatocytes, identified by light microscopy to be at the premeiotic interphase stage, were found to be heavily labeled. Electron microscopic examination disclosed the coincidental occurrence of synaptonemal complexes and label within the nuclei of premeiotic interphase spermatocytes, indicating synapses of homologues had begun during the S phase. The significance of this finding for the traditional view of meiosis is discussed.

17476 **Effects of polyethylene glycol on reverse transcriptase and other polymerase activities.** Chan, E.W.; Dale, P.J.; Greco, I.L.; Rose, J.G.; O'Connor, T.E. (Argonne National Lab., IL). *Biochimica et Biophysica Acta ;* **606**: 353-361(1980).

Polyethylene glycol enhances reverse transcription, augmenting both the rate and duration of polymerization. The effective mean molecular weight of polyethylene glycol is 6000 and the optimal concentration is 12% (w/w). Polyethylene glycol is effective on the reverse transcriptase reaction of all ten type B, C, and D viruses tested under a variety of exogenous, endogenous, and reconstitution assay systems, including the highly efficient conditions involving calf thymus DNA oligonucleotide primers. By three methods of synthesis, polyethylene glycol increased the yields of complementary [^{3}H]DNA by a factor of 1.8-6.5. Polyethylene glycol does not alter the divalent cation requirements or the specificities of the enzyme. Complementary [^{3}H]DNAs made in the presence of polyethylene glycol are indistinguishable in terms of size and sequence complementarity from those made in the absence of the polymer. The stimulatory effect was partly due to the ability of polyethylene glycol to stabilize reverse transcriptase. Preliminary tests indicate that polyethylene glycol also stimulates other nucleotide polymerases, such as the DNA-dependent DNA and RNA polymerases of Escherichia coli and the terminal transferase of calf thymus.

17477 **DNA synthesis in a sub-nuclear preparation isolated from Physarum polycephalum.** Brewer, E.N.; Busacca, P.A. (Case Western Reserve Univ., Cleveland, OH). *Biochemical and Biophysical Research Communications ;* **91**: No. 4, 1352-1357(28 Dec 1979).

A sub-nuclear preparation capable of substantial levels of DNA synthesis in vitro has been obtained from isolated S-phase nuclei of Physarum polycephalum. Nuclei were disrupted by gentle resuspension in a dextran-free medium followed by immediate addition of dextran to stabilize the liberated replication complex. Synthesis continues for at least 120 min, and appears to occur by a semi-discontinuous mechanism. Little DNA synthesis occurs in preparations obtained from G_2-phase nuclei.

17478 Effects of local anesthetics on cholinergic agonist binding affinity of central nervous system α-bungarotoxin receptors. Lukas, R.L.; Bennett, E.L. (Univ. of California, Berkeley). *FEBS (Federation of European Biochemical Societies) Letters ;* **108**: No. 2, 356-358(Dec 1979).

In general, pharmacological effects of local anesthetics may be attributed to their ability to reversibly block the propagation of nerve and muscle action potentials. At physiologically potent concentrations, local anesthetics (LA) also act as noncompetitive antagonists of the physiological response of post-synaptic nicotinic acetylcholine receptors (nAChR) to cholinergic agonists, and increase agonist binding affinities of nAChR from electric organ. It is postulated that the primary site of LA action on nAChR function is at the receptor-coupled ionophore. Furthermore, LA-nAChR ionophore interactions are thought to accelerate physiological desensitization of nAChR, manifest biochemically as increased affinity of nAChR for agonist. Specific receptors for α-bungarotoxin (α-Bgt), a potent competitive antagonist at nAChR sites in the periphery, have been detected in rat central nervous system membrane preparations. The affinity of these central α-Bgt receptors (α-BgtR) for cholinergic agonists is found to increase on exposure to agonist. Nevertheless, on the basis of inconsistent pharmacological and physiological results, uncertainty remains regarding the relationship between α-BgtR and authentic nAChR in the CNS, despite a wide body of biochemical and histological evidence consistent with their identity. Reasoning that if CNS α-BgtR are true in nAChR, coupled to functional ion channels, LA might be expected to cause biochemically measurable increases in α-BgtR affinity for cholinergic agonists, we have undertaken a study of the effects of LA on the ability of acetylcholine (ACh) to inhibit interaction of α-BgtR with ^{3}H-labeled α-Bgt.

17479 Hydrogen formation in nearly stoichiometric amounts from glucose by a Rhodopseudomonas sphaeroides mutant. Macler, B.A. (Univ. of California, Berkeley); Pelroy, R.A.; Bassham, J.A. *Journal of Bacteriology ;* **138**: No. 2, 446-452(May 1979).

Rhodopseudomonas sphaeroides produces molecular H_2 and CO_2 from reduced organic compounds which serve as electron sources and from light which provides energy in the form of adenosine 5'-triphosphate. This process is mediated by a nitrogenase enzyme. A mutant has been found that, unlike the wild type, will quantitatively convert glucose to H_2 and CO_2. Techniques for isolated other strains capable of utilizing other unusual electron sources are presented. Metabolism of glucose by the wild-type strain leads to an accumulation of gluconate. The isolated mutant strain does not appear to accumulate gluconate.

17480 Thermal denaturation of chromatin and lysine copolymer-DNA complexes. Effects of ethylene glycol. Schwartz, A.M.; Fasman, G.D. (Brandeis Univ., Waltham, MA). *Biopolymers ;* **18**: 1045-1063(1979).

Chromatin was thermally denatured in the presence and absence of 1M ethylene glycol using a technique whereby both the hyperchromism and ellipticity are monitored simultaneously. Model complexes containing poly(L-Lys) or poly(L-Lys,L-Ala,Gly) and DNA were similarly melted in order to assist in interpreting the chromatin results. In both cases a general pattern emerged whereby ethylene glycol perturbed the resultant metling profile, showing increased hyperchromicity, ellipticity, and premelt slope. In addition, ethylene glycol destabilizes and reduces the high melting region of polypeptide-bound DNA and the extent of higher ordered structure in model complexes and chromatin. These results emphasize the importance of hydrophobic forces in polypeptide-polypeptide and polypeptide-DNA interactions.

17481 Quantitation of labile keto bile acids in biological samples by sodium borodeuteride reduction prior to isolation and isotope ratio measurements of hydroxyl bile acids. Tserng, K.Y.; Klein, P.D. (Argonne National Lab., IL). pp 147-151 of Stable isotopes. New York, NY; Academic Press (1979).

The labile keto bile acids in human bile were reduced with sodium borodeuteride prior to isolation. The extent of keto bile acids was then quantitated by isotope ratio measurements of the increase in the M+1 ion intensity over natural abundance. The results show that existing analytical methods, using conventional alkaline hydrolysis procedures, substantially underestimate the content of keto bile acids present in samples. The use of stable isotopic techniques provides an accurate alternative for keto bile acid determination and can thus be used to validate the suitability of the enzymatic deconjugation procedure in the analysis of keto bile acids.

17482 Growth hormone and somatomedins. Wiedemann, E. (Univ. of California, Berkeley). pp 93-110 of Recent advances in the diagnosis and treatment of pituitary tumors. Linfoot, J.A. (ed.). New York, NY; Raven Press (1979).

Because of space limitations, this review of the physiology of growth hormone (GH) and the Somatomedins must be highly selective. Specific aspects of GH research such as GH chemistry, biological actions, structure-function relationships, and regulation of secretion, as well as the present state of somatomedin research, were recently reviewed.

17483 Magnetophotoselection of the triplet state of reaction centers from Rhodopseudomonas sphaeroides R-26. Frank, H.A.; Bolt, J.; Friesner, R.; Sauer, K. (Univ. of California, Berkeley). *Biochimica et Biophysica Acta ;* **547**: 502-511(1979).

Reaction centers of the photosynthetic bacterium Rhodopseudomonas sphaeroides R-26, give rise to large triplet state EPR signals upon illumination at low temperature (11 K). Utilizing monochromatic polarized light to generate the EPR spectra (magnetophotoselection) we have shown that the intensities of the observed triplet signals are strongly dependent upon the wavelength and polarization direction of the excitation. These data can be used to calculate the orientations of the excited transition moments with respect to each other and with respect to the triplet state principal magnetic axes system. Our quantitative approach is to follow the procedure outlined in a previous publication where computer simulations of the observed triplet state spectra were employed. The results presented in the present work indicate that the transition moment at 870 nm which is associated with the bacteriochlorophyll special pair lies almost entirely along one of the principal magnetic axes of the triplet state. Also, the 870 nm transition moment makes an angle of approx. 60°C with 546 nm transition moment which is associated with a bacteriopheophytin. This latter result is in agreement with previous photoselection studies on the same bacterial species.

17484 Sequence organization of the soybean genome. Gurley, W.B.; Hepburn, A.G.; Key, J.L. (Univ. of Georgia, Athens). Contract AS09-76EV00643. *Biochimica et Biophysica Acta ;* **561**: 167-183(1979).

The total complexity of one constituent soybean (Glycine max) genome is estimated to be $1.29.10^9$ nucleotide pairs, as determined by analysis of the reassociation kinetics of sheared (0.47 kilobase) DNA. Single copy sequences are estimated to represent from 53 to 64% of the genome by analysis of hydroxyapatite binding of repetitive DNA as a function of fragment length. From 65 to 70% of these single copy sequences have a short period interspersion with 1.11 to 1.36 kilobase lengths alternating with 0.3 to 0.4 kilobase repetitive sequence elements. The repetitive sequences of soybean DNA are interspersed both among themselves and among single copy regions of the genome.

17485 Photosynthesis: the light reactions. Sauer, K. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Annual Review of Physical Chemistry ;* **30**: 155-178(1979).

During the past three or four years there has been a substantial advance in our knowledge of the light reactions in photosynthesis. This comes at a time of heightened interest in sunlight as a source of energy for our daily needs. The exploration of potential practical applications in this area will be helped by identifying the common features of the light reactions in higher plants and algae and in the simpler photosynthetic bacteria. These include the processes of light absorption by an antenna of chlorophyll (Chl) and other pigment molecules, the transfer of excitation to a photochemical reaction center, and the initiation of the electron transfer reactions - all within a few picoseconds of the arrival of the photon.

5503 Cytology

REFER ALSO TO CITATION(S) 17157, 17470, 17475, 17477, 17489, 17502, 17518, 17522

17486 **Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts.** Parry, G.; Bartholomew, J.C.; Bissell, M.J. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Nature (London) ;* **288**: No. 5792, 720-722(Dec 1980).

We report here a study of the mechanisms leading to loss of growth control in chicken embryo fibroblasts transformed by Rous sarcoma virus (RSV). We have been particularly concerned with the role of the SRC gene in this process, and have used RSV mutants temperature sensitive (ts) for transformation to investigate the nature of the growth regulatory lesion. The two principal findings were (1) the stationary phase of the cell cycle (G_1) in chick embryo fibroblasts seems to have two distinct regulatory compartments (2) whereas normal cells can occupy either state depending on culture conditions, the ts-infected cells, at 41.5°C, do not seem to enter Q even though a known src gene product, a kinase, is reported to be inactive at this temperature. We discuss the possibility that viral factors other than the active src protein kinase influence growth control in infected cultures.

5504 Genetics

REFER ALSO TO CITATION(S) 17484, 17486, 17499, 17501, 17529

17487 **Immunoreactive helix-destabilizing protein localized in transcriptionally active regions of Drosophila polytene chromosomes.** Patel, G. L.; Thompson, P.E. (Univ. of Georgia, Athens). *Proceedings of the National Academy of Sciences of the United States of America ;* **77**: No. 11, 6749-6753(Nov 1980).

A highly purified helix-destabilizing protein (HDP) obtained from rat liver has been used to elicit specific, high-titer anti-HDP sera in rabbits. These antisera show immunological crossreaction with single-stranded DNA binding proteins from several very diverse eukaryotic sources, including Drosophila embryos. The use of such antisera in the labeling of Drosophila salivary gland chromosomes buy indirect immunofluorescence shows concentrations of immunoreactive HDP in many regions, but especially in chromosome puffs. There is a striking localization of HDP in heat shock puffs known to be sites of new transcription. The pattern of HDP distribution seems to implicate a transcriptional role, with some specificities independent of puffing itself.

17488 **Genetic and physical mapping in the early region of bacteriophage T7 DNA.** Studier, F.W.; Rosenberg, A.H.; Simon, M.N.; Dunn, J.J. (Brookhaven National Lab., Upton, NY). *Journal of Molecular Biology ;* **135**: 917-937(1979).

A detailed physical map of the early region of bacteriophage T7 DNA was constructed. This map contains: locations for all the cuts made by the restriction endonucleases HindII, HpaII, HaeIII, and HaeII, and many of the cuts by HhaI; the approximate end points for each of 61 different deletions; initiation sites and the termination site for RNAs made by Escherichia coli RNA polymerase; an initiation site for RNA made by T7 RNA polymerase; the five primary RNase III cleavage sites of the early region; and the coding sequences for perhaps nine different early proteins. Virtually all of the non-overlapping coding capacity of the five early messenger RNAs is used, except for untranslated stretches of perhaps 30 or so nucleotides at the ends. It seems likely that each of the nine early proteins is made from its own ribosome-binding and initiation site. The mapped restriction cuts provide fixed reference points, and allow DNA fragments containing specific genetic signals to be identified and isolated. The nucleotide sequences around the ends of three different T7 deletions have been determined. Each deletion eliminated a segment of DNA between repeated sequences of seven, eight or ten base-pairs, located 578 to 2100 base-pairs apart in the wild-type sequence. In each case, one copy of the repeated sequence was retained in the deletion mutant. This is consistent with the deletions having arisen by a genetic crossover between the repeated sequences. The approximate frequency of genetic recombination per base-pair has been estimated within two early genes.

5505 Metabolism

REFER ALSO TO CITATION(S) 17157, 17473, 17474, 17479, 17482

17489 **(DOE/EV/10268—1) Threshold effects and cellular recognition. Progress report.** Rando, R.R. (Harvard Medical School, Boston, MA (USA)). 1980. Contract AC02-79EV10268. 12p. NTIS, PC A02/MF A01.

In the first year we focused on developing the techniques required for the successful incorporation of synthetic glycolipids into cells. To these ends a new water-soluble spacer group (8-amino-3-6-dioxaoctanoic acid) was developed and incorporated into the cholesterol based synthetic glycolipids. These glycolipids could be incorporated into liposomes, rendering them susceptible to aggregation by the appropriate lectin. They aiso allowed us to define the minimal distance between the sugar moiety and membrane required for agglutination. Finally and most importantly, we were able to functionally incorporate these new glycolipids in cells and render them agglutinable with the appropriate lectins. Functional incorporation does not occur with glycolipids bearing hydropholic spacer groups. We are now in a position to begin using the new glycolipids to answer questions about the roles of cell surface sugars in cellular recognition, which is the subject of this renewal proposal.

5506 Medicine

REFER ALSO TO CITATION(S) 17192, 17192, 17194, 17195, 17196, 17199, 17503, 17512, 17512, 17514, 17525

17490 (DOE/EV/04115—4, pp 46-53) **Development and clinical application of the Os-191 → Ir-191m generator.** Treves, S.; Cheng, C. Oct 1980.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981.

An osmium-191 → iridium-191m generator that can deliver multiple doses of Ir-191m for first-pass radionuclide angiography has been developed. The Os-191 is loaded on an anion exchange column (AGMP-1) and Ir-191m eluted with 0.9% NaCl at pH 1. Each elution (0.6 to 1 ml) of the generator yields about 7 to 10% Ir-191m and gives 0.003 to 0.005% of Os-191 breakthrough. Toxicity studies of the generator eluate carried out in animals support the safety of using iridium-191m in humans. This new 0s-Ir generator system has been approved for human use at Children's Hospital Medical Center. This radionuclide generator was used to obtain angiogram in 94 patients. In twelve patients who underwent Ir-191m angiography and cardiac catheterization simultaneously, there was good correlation coefficient in the measurement of pulmonary to systemic flow ratio.

17491 **(LBL—11858) Imaging properties of a positron tomograph with 280 BGO crystals.** Derenzo, S.E.; Budinger, T.F.; Huesman, R.H.; Cahoon, J.L.; Vuletich, T. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Donner Lab.). Nov 1980. Contract W-7405-ENG-48. 16p. (CONF-801103—56). NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; Orlando, FL, USA (5 Nov 1980).

The basic imaging properties of the Donner 280-BGO-Crystal positron tomograph were measured and compared with the same system when it was equipped with 280 NaI(T1) crystals. The NaI(T1) crystals were 8 mm x 30 mm x 50 mm deep, sealed in 10 mm wide stainless steel cans. The BGO crystals are 9.5 mm x 32 mm x 32 mm deep and as they are not hygroscopic do not require sealed cans. With a shielding gap of 3 cm (section thickness 1.7 cm FWHM) the sensitivity of the BGO system is 55,000 events per sec for 1 μCi per cm^3 in a 20 cm cylinder of water, which is 2.3 times higher than the NaI(T1) system. For a 200 μCi/cm line source on the ring axis in a 20 cm diameter water cylinder, the BGO system records 86% of the scatter fraction and 66% of the accidental fraction of the NaI(T1) system. The lower light yield and poorer time resolution of BGO requires a wider coincidence timing window

than NaI(Tl). However, the ability to use full-energy pulse height selection with a 2.3-fold improvement in sensitivity results in an overall reduction in the fraction of accidental events recorded. The in-plane resolution of the BGO system is 9 to 10 mm FWHM within the central 30 cm diameter field, and the radial elongation at the edge of the field in the NaI(Tl) system has been nearly eliminated.

17492 **Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging.** Kulmala, H.K. (Univ. of Chicago, IL);; Huang, C.C.; Dinerstein, R.J.; Friedman, A.M. *Life Sciences ;* **28**: No. 17, 1911-1916(27 Apr 1981).

The binding of the gamma labeled neuroleptic, ^{77}Br-p-bromospiroperidol, in the rat brain was examined in vivo. This binding parallels the binding of ^{3}H-spiroperidol, in that binding is especially high in dopaminergically innervated areas, is saturable, and is displaced by high doses of unlabeled spiroperidol. Thus, ^{77}Br-p-bromospiroperidol is a suitable ligand for use in gamma ray imaging techniques for in vivo monitoring of receptor binding.

17493 **Serum copper and zinc levels in melanoma patients.** Fisher, G.L. (Battelle Columbus Labs., OH); Spitler, L.E.; McNeill, K.L.; Rosenblatt, L.S. *Cancer ;* **47**: No. 7, 1838-1844(1 Apr 1981).

Serum copper levels (SCL) and serum zinc levels (SZL) were evaluated in malignant melanoma patients at various clinical stages. Copper levels were generally found to be elevated, reflecting the degree and extent of tumor activity. Zinc levels and, hence, SCL:SZL ratios did not reflect tumor activity. SCL appeared to prognosticate disease progression in that all patients whose values never declined below 150 μg/100 ml died during the course of the study. However, not all patients who died from tumor metastases displayed persistent elevations of SCL. Patients receiving BCG immunotherapy appeared to have higher SCL than untreated patients.

17494 **Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid.** Kumar, B.; Miller, T.R.; Siegel, B.A.; Mathias, C.J.; Markham, J.; Ehrhardt, G.J.; Welch, M.J. (Washington Univ., St. Louis, MO). *American Journal of Roentgenology ;* **136**: No. 4, 685-690(Apr 1981).

A new radiopharmaceutical, ^{68}Ga iron hydroxide colloid, for hepatic imaging by positron emission tomography was prepared from the eluate of a ^{68}Ge-^{68}Ga solvent extraction generator. In rats, 84% of the administered dose of colloid localized in the liver and 4.6% accumulated in the spleen. Initial imaging studies in normal dogs showed close correspondence of the findings by positron tomography and transmission computed tomography. Emission tomography with ^{68}Ga-colloid was performed in 10 patients with hepatic metastases demonstrated by conventional /sup 99m/Tc-sulfur colloid scintigraphy. All focal defects noted on the conventional scintigrams were easily identified and generally were seen more clearly by positron tomography. In one patient, additional lesions not identified on the initial /sup 99m/Tc-sulfur colloid images were demonstrated. The positron tomographic images were compared with those obtained by transmission computed tomography in seven patients; the two studies showed comparable findings in five patients, whereas positron tomography more clearly showed multiple lesions in two. Our results suggest that positron emission tomography is a suitable technique for obtaining high contrast, cross-sectional images of large abdominal organs.

17495 **Fecal ^{13}C analysis for the detection and quantitation of intestinal malabsorption.** Schoeller, D.A.; Klein, P.D.; MacLean, W.C. Jr.; Watkins, J.B.; Van Santen, E. (Univ. of Chicago, IL). Contract W-31-109-ENG-38. *Journal of Laboratory and Clinical Medicine, The ;* **97**: No. 3, 439-448(Mar 1981).

The use of $^{14}CO_2$ breath tests and fecal analyses for the detection and quantitation of intestinal malabsorption has been extensively documented in adult subjects. The use of stable isotopes has extended the range of breath test applications to include pediatric and obstetric subjects. Here we report a fecal ^{13}C analysis that can be used in conjunction with $^{13}CO_2$ breath tests. Twenty-four-hour fecal samples were collected before and after the administration of a labeled substrate. The samples were homogenized and combusted to CO_2, and the ^{13}C abundance was determined by high-precision, differential isotope ratio mass spectrometry. The isotopic variation between successive 24 hr fecal samples was 0.6 per thousand (0.0006 atom percent). This variation limited the sensitivity of the fecal analysis to 13 μmol of ^{13}C label per mole of fecal carbon. Simultaneous cholyglycine $^{13}CO_2$ breath tests and fecal assays were performed in five children. One child with bacterial overgrowth had an abnormal breath test and a normal fecal test. Of three children with ileal dysfunction, only one had an abnormal breath test, whereas the fecal test was abnormal in all three. Both the breath test and fecal test were abnormal for a child who had undergone an ileal resection. Both tests were normal for a child with ulcerative colitis.

17496 **Observed detector characteristics in mammography: suggestions for further studies.** Kunio, D.; Holje, G. (Univ. of Chicago, IL). pp 167-170 of Reduced dose mammography. New York, NY; Masson Publishing USA, Inc. (1979).

From Reduced dose mammography symposium; Buffalo, NY, USA (4 Oct 1978).

Patient exposure in mammography must be minimized without sacrifice of the diagnostic quality of mammograms. The choice of an appropriate recording or detector system with which this goal can be achieved in mammography is therefore very important, since the speed of the system is directly related to the patient exposure and since its imaging properties influence the diagnosis significantly. Although a number of different recording systems have been used in mammography, few physical evaluations of these systems have been reported in the literature.

17497 **Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978.** Klein, E.R.; Klein, P.D. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Biomedical Mass Spectrometry ;* **6**: No. 12, 515-545(1979).

The first biennial updated compilation, for the period 1977-1978, of selected references to the use of ^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S in biochemical, pharmacological, clinical, and environmental applications is presented. Author and subject indices for this information are compiled to enable the reader to make further use of these references.

5507 Microbiology

REFER ALSO TO CITATION(S) 16402, 16564, 16614, 17479, 17483, 17488, 17540

17498 **Orientation of the primary donor in bacterial photosynthesis.** Frank, H.A.; Friesner, R.; Nairn, J.A.; Dismukes, G.C.; Sauer, K. (Univ. of California, Berkeley). *Biochimica et Biophysica Acta ;* **547**: 484-501(1979).

The triplet state EPR spectra of magnetically aligned whole cells of Rhodopseudomonas viridis and Rhodopseudomonas palustris display a marked dependence on the orientation of the static EPR field with respect to the alignment field direction. This observation implies that the primary donor species on which the triplets are localized are ordered within the membranes. We have developed a theoretical model for the system to enable calculation of the orientation of the magnetic axes of the primary donor species with respect to the membranes in which they reside. The triplet state spectra are generated by an ensemble of partially ordered magnetic systems and a computer simulation of the experimental results. The triplet orientation is very similar for the two organisms studied, where one axis lies predominantly in the plane of the membrane and the other two axes have approximately equal projections onto the normal to the membrane.

17499 **How the NIH recombinant DNA Molecule Committee works in 1979.** Setlow, J.K. (Brookhaven National Lab., Upton, NY). pp 161-164 of Recombinant DNA and genetic experimentation. Morgan, J.; Whelan, W.J. (eds.). New York, NY; Pergamon Press (1979).

Concerns are expressed that present controls on recombinant DNA research are too restrictive. Many members of the Recombinant DNA Molecular Advisory Committee (RAC) currently think

that some of the earlier concerns of the potential hazards of recombinant molecular research are not realistic. The task of the present RAC is to assemble documentation and justification for any proposed relaxation or elimination of all or parts of the Guidelines. Methods used to accomplish this task are described.

5508 Morphology

REFER ALSO TO CITATION(S) 17475

17500 **(CONF-8004147—1) Role of brain maturation and reproductive history in the evolution of the primate brain.** Sacher, G.A. (Argonne National Lab., IL (USA)). 1980. Contract W-31-109-ENG-38. 25p. NTIS, PC A02/MF A01.

From Annual meeting of the American Association of Physical Anthropologists; Niagara Falls, NY, USA (19 Apr 1980).

All primates conform to a 12% ratio of brain weight to body weight throughout fetal life. This pattern evolved at the beginning of primate evolution, initially as an adaptation to the low energy density of the insect food resource in a strictly arboreal habitat. However, when a wider range of food resources became available, the higher primates retained the 12% trajectory and made it the basis for rapid evolution toward large brain size, which would not have been possible within the restrictions imposed by the 6% brain growth trajectory. The 12% trajectory originally evolved to reduce maternal investment in an energy-poor environment, but became a preadaptation to brain expansion once the energy limitation was overcome by the development of herbivory and frugivory by the higher primates.

5509 Pathology

REFER ALSO TO CITATION(S) 17469, 17493, 17502

17501 **Aggregation of deaths from ischaemic heart disease among first and second degree relatives of 108 males and 42 females with myocardial infarction.** Thordarson, O.; Fridriksson, S. (Univ. of Iceland, Reykjavik). Contract EY-76-C-02-3214. *Acta Medica Scandinavica ;* **205**: No. 6, 493-500(1979).

The occurrence of deaths due to ischaemic heart disease (IHD) among first and second degree relatives of coronary patients and among relatives of an equal number of matched controls was studied on the basis of death certificates. The propositi were 108 males and 42 females, who had developed myocardial infarction (MI), males before 65 years of age and females before 70. When compared with controls, a 1-1/2-fold higher death rate was found among first degree relatives of the propositi and a lower average age at death. The difference in death rate between second degree relatives was not significant, except for maternal brothers. When compared with the death rate due to IHD in the general population, the increase in risk to first degree relatives of propositi was nearly 3-fold over the expected value, and 1-1/2-fold to second degree relatives. The age of the propositi at onset of MI did not affect the risk to relatives, whereas sex-related influence was significant. To first degree relatives of male propositi the risk increase was up to 5-fold over the expected value. The risk increase was found to be greatest to first degree male relatives of female propositi, or over 7-fold to fathers and brothers. Mothers and sisters of both male and female propositi showed a 4 to 5 fold risk increase over the expected value. The risk increase to second degree relatives was 2-1/2-fold over the expected value to maternal brothers of male propositi and 4-fold to such brothers of female propositi. The relatives of controls showed a coronary mortality close to that of the general population. Familial clustering of coronary deaths was found in 8.7% of the families of the propositi and in 4.7% of the families of the controls. The findings of the present study indicate a substantial genetic component in the overall aetiology of IHD, which is more prominent in families of female propositi but hardly of a magnitude to warrant genetic counseling.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 17157, 17469, 17470, 17471, 17478, 17482, 17492, 17493, 17496, 17500, 17515, 17517, 17535, 17536, 17540

17502 **(DOE/EV/02401—T1) Cellular proliferation and regeneration following tissue damage. Final report.** Harding, C.V. (Wayne State Univ., Detroit, MI (USA). Kresge Eye Inst.). 1981. Contract AS02-76EV02401. 11p. NTIS, PC A02/MF A01.

The mechanisms which control cellular proliferation during wound healing in tissues of the eye were studied using the effects of chemical and physical injuries on the initiation of the cell cycle in the rabbit lens and cornea. This was extended to a study of neovascularization following injury. The rabbit ocular lens in organ culture was used as an in vitro model system. The action of mitogenic agents (e.g., serum, insulin) on macromolecular synthesis and ultrastructure was analyzed in the cultured lens. Three subphases between explantation of the lens into a serum-containing medium, and the initiation of DNA synthesis were described and characterized. In the sequence of ultrastructural and macromolecular changes, changes in the cell membranes and cell-to-cell relationships were the earliest. Changes in cell communication are suggested as primary events in triggering the cell cycle. Therefore, the organization of the junctional complexes was studied in normal tissues, and in tissues at different times after injury in vivo, or exposure to mitogenic agents in vitro. The regeneration of corneal epithelium and endothelium was also analyzed, using newly-developed preparative techniques for scanning electron microscopy. Also, the stimulation of neovascularization in ocular tissues was studied, using procedures developed with the ocular lens. Emphasis was placed on the development of in vivo and in vitro systems for the testing of potentially-toxic compounds involved in the processing of fossil fuels. A major effort was devoted to a study of the early stages of lens fiber cell degeneration, procedures being worked out for the ultrastructural and elemental analysis of specific human lens opacities, localized by stereo-photographic procedures. In this study, the techniques of Energy Dispersive X-ray Analysis (EDXA) were used in combination with scanning electron microscopy. (ERB)

17503 **(UR—3490-1977) Evaluation of the physical properties of monodisperse and heterodisperse aerosols used in the assessment of bronchial function.** Morrow, P.E. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1981. Contract AC02-76EV03490. 17p. (CONF-810243—1). NTIS, PC A02/MF A01.

From Workshop on mucociliary clearance; Miami Beach, FL, USA (17 Feb 1981).

The essential features of monodisperse and heterodisperse aerosols are briefly reviewed in their application to the quantitative assessment of particle deposition and retention in the human bronchial airways. A basis is sought for comparing both the advantages and the limitations of extant approaches developed for bronchial investigations, to those which could be developed utilizing the best available scientific and technologic information. The optimal requirements for efficacious, targeted aerosols in evaluating bronchial function, e.g., mucociliary transport, and in treating bronchial dysfunctions, e.g., excessive bronchomotor tone, are the ultimate objective of this exercise and the reason for the Workshop.

17504 **Rheology of suspensions of normal and hardened erythrocytes and their mixtures.** Carr, R.; Cockelet, G.R. (Univ. of Rochester School of Medicine and Dentistry, New York). Contract DE-AC02-76EV03490. *Journal of Rheology ;* **25**: No. 1, 67-82(Feb 1981).

The steady-flow rheological properties of suspensions of mixtures of normal and glutaraldehyde-hardened human red blood cells in albumin-containing saline were determined in the shear rate range of 0.1 to 1500 sec^{-1}, for total cell volume concentrations (hematocrits) between 30 and 43.5% and over the entire range of normal-to-hardened cell ratios. Suspensions of only hardened cells were Newtonian at lower shear rates, becoming dilatant at high shear rates. Suspensions of just normal cells were pseudoplastic, becoming Newtonian at high shear rates. Suspensions of mixtures of the two types of cells showed mixed behavior, dependent on the

mixture composition. For suspensions with a constant total cell volume concentration, the apparent viscosity at a given shear rate is a nonlinear function of the fraction of the cells (f/sub H/) which are hardened. Below a critical value of f/sub H/, viscosity is a linear function of f/sub H/, but the slope is low. Above the critical f/sub H/, viscosity increases rapidly with f/sub H/. The critical f/sub H/ is associated with a critical hardened cell volume concentration where interactions between hardened cells become significant. It is expected that steady-flow rheological measurements usually will not provide a sensitive method for determining changes in erythrocyte deformability distribution in blood or related suspensions, unless the abnormal cells are rigid and greatly distorted from the normal cell shape.

17505 **Simple light-level recording device to monitor lighting in animal quarters.** Cunningham, J.J.; Doss, J.D. (Los Alamos Scientific Lab., NM). *Laboratory Animal Science ;* **29**: No. 6, 809-811(Dec 1979).

The performance of lighting timers in animal rooms was tested with a portable light-level recorder. The instrument monitored the light and dark phases under various degrees of illumination. This inexpensive method of electronic surveillance ensured the validity of experiments dependent on photoperiodicity.

5520 Public Health

REFER ALSO TO CITATION(S) 17381, 17412, 17421, 17501

17506 (PNL—3700(Pt.5), pp 63-64) **Personnel dosimetry calibrations.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

A base of technical information will be acquired and developed for evaluating the calibration, design and performance of dosimeters used at Department of Energy (DOE) facilities. A technical document will be prepared to guide DOE and DOE contractors in selecting appropriate personnel dosimetry calibrations. Draft criteria presented by the American National Standards Institute (ANSI 1978) will be used as a guide for establishing recommended dosimeter calibration and irradiation procedures.

17507 (PNL—3700(Pt.5), pp 65-68) **Health physics lead laboratory.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

Pacific Northwest Laboratory functions as the lead laboratory providing health physics support and assistance to the Division of Operational and Environmental Safety, US DOE, on special studies principally associated with the analysis of impact of standards, regulations, and engineering and administrative actions on occupational and environmental exposure. Included in this support are data base management for personnel dosimetry; assessment and analysis of personnel neutron dosimetry; field testing, calibration, and standardization techniques for neutron spectrometry; preparation of a guide for reducing radiation exposures; and radiation surveys of nuclear facilites and characterization of DOE facilities emergency preparedness. (DLS)

17508 (PNL—3700(Pt.5), pp 69-70) **Analysis of criticality safety.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

Data has been collected on more than 400 nuclear criticality safety infractions that occurred at DOE nuclear facilities covering a period of some six years. The development and application of a systematic method to analyze the criticality safety program in DOE facilities was begun for fault tree analysis purposes. (DLS)

17509 (PNL—3700(Pt.5), pp 75-76) **Statistical health-effects study.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The main purpose of this program is to analyze the mortality of Hanford workers and to determine the effects of radiation exposure in this population. A secondary objective is the development of improved methodology for assessing health effects of chronic low-level exposure to harmful agents or substances, particularly in an occupational setting. In the past year PNL has presented published results of updated analyses, presented papers in two areas of methodological research, and have worked with staff of the Hanford Environmental Health Foundation to improve data collection procedures.

17510 (PNL—3700(Pt.5), pp 77) **Radioisotope customer list.** Feb 1981.

In Pacific Northwest Laboratory annual report for 1980 to the DOE Assistant Secretary for Environment. Part 5. Environmental assessment, control, health and safety.

The purpose of this program is to prepare and distribute the annual document entitled List of DOE Radioisotope Customers with Summary of Radioisotope Shipments FY 1979. This document lists the FY 1979 commercial radioisotope production and distribution activities of the Department of Energy (DOE) facilities at Argonne National Laboratory, Brookhaven National Laboratory, Hanford Engineering Development Laboratory, Idaho Operations Office/Aerojet Nuclear Co., Los Alamos Scientific Laboratory, Mound Facility, Pacific Northwest Laboratory, Oak Ridge National Laboratory, Rocky Flats, Savannah River Plant/DOE, and United Nuclear Industries, Inc.

5530 Agriculture And Food Technology

17511 **(LA-UR—81-748) Electronic weighing, identification and subdermal body temperature sensing of range livestock.** Anderson, D.M.; Landt, J.A.; Salazar, P.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-8010174—1). NTIS, PC A02/MF A01.

From Joint US/Australian workshop on forage evaluation and utilization: an appraisal of concepts and techniques; Armidale, Australia (27 Oct 1980).

Individual animal weights can be obtained manually or automatically in a computer-compatible format with an electronic scale. If an electronic identification, subdermal body temperature sensing unit is interfaced with an electronic scale, the weight, identification, and subdermal body temperature of individually identified animals can be obtained either manually or automatically, and transcriptional and phonetic errors thus eliminated. Electronics can be used at remote locations despite extreme temperatures, dust, and fluctuation in battery power. For research purposes, daily weight fluctuations, watering behavior, and subdermal body temperature can be recorded continuously. When the system becomes commercially available, increased livestock production at a lower cost will be possible.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 17199, 17249, 17422, 17422, 17422, 17509, 17530, 17532, 17743

17512 **(BNL—28921) Melanin-binding radiopharmaceuticals.** Packer, S.; Fairchild, R.G.; Watts, K.P.; Greenberg, D.; Hannon S.J. (Brookhaven National Lab., Upton, NY (USA); North Shore Univ. Hospital, Manhasset, NY (USA). Div. of Ophthalmology; Cornell Univ., New York (USA). Medical Coll.). 1980. Contract AC02-76CH00016. 21p. (CONF-800336—3). NTIS, PC A02/MF A01.

From Radiopharmaceuticals: structure activity relationships symposium; Hartford, CT, USA (21 Mar 1980).

The scope of this paper is limited to an analysis of the factors that are important to the relationship of radiopharmaceuticals to melanin. While the authors do not attempt to deal with differ-

ences between melanin-binding vs. melanoma-binding, a notable variance is assumed. (PSB)

17513 **(UR—3490-1981) Tracheobronchial clearance studies in the guinea pig.** Velasquez, D.J. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1981. Contract AC02-76EV03490. 172p. NTIS, PC A08/MF A01. Thesis.

Tracheobronchial clearance in guinea pigs exposed to relatively monodisperse aerosols was studied. Two new techniques were developed which enabled tagging of polystyrene particles with ^{198}Au and with a fluorescent dye. A procedure was also developed to generate polystyrene particles with a vibrating orifice generator. Seventy animals were exposed via inhalation to relatively monodisperse polystyrene aerosols. Following exposure, animals were radioactively counted at regular intervals, sacrificed at predetermined times, and the lungs were removed, inflated to a standard pressure, frozen in liquid nitrogen, and freeze-dried. The freeze-dried lungs were sectioned completely, examined with a fluorescent microscope, and measurements were made of airway diameters in which particles were found. The results indicated a significant penetration of particles to the distal bronchioles and air spaces for 7.9 μm (MMD) particles and a lesser, though still significant, penetration for 10.3 μm (MMD) particles. An anatomical model for guinea pig lung morphology was used to classify particular ranges of airway diameters into zones. These zones were used to specify a compartmental model for lung clearance and the experimental particle distributions were categorized using this model. Equations were then developed describing the compartmental clearance. Rate constants were then obtained and used to predict airway transport rates in specific lung generations.The predicted transport rates ranged from approximately 0.001 mm/min in the distal bronchioles to approximately 8 mm/min in the trachea. These values agree with previous models for airway transport rates, and are consistent with experimental determinations of tracheal transport rates. Transit times were calculated and the results indicate a 24 hr clearance time for tracheobronchial clearance in the guinea pig. (ERB)

17514 **Astatine-211-tellurium radiocolloid cures experimental malignant ascites.** Bloomer, W.D. (Harvard Medical School, Boston, MA); McLaughlin, W.H.; Neirinckx, R.D.; Adelstein, S.J.; Gordon, P.R.; Ruth, T.J.; Wolf, A.P. Contract EY-76-S-4115; AC02-76CH0016. *Science ;* **212**: No. 4492, 340-341(17 Apr 1981).

An investigation of the efficacy of astatine-211-tellurium colloid for the treatment of experimental malignant ascites in mice reveals that this α-emitting radiocolloid can be curative without causing undue toxicity to normal tissue. By comparison, negatron-emitting phosphorus-32 as colloidal chromic phosphate had no antineoplastic activity. The most compelling explanation for this striking difference is the dense ionization and short range of action associated with α-emission. These results have important implications for the development and use of α-emitters as radiocolloid therapy for the treatment of human tumors.

17515 **Metabolic mapping of the brain's response to visual stimulation: studies in humans.** Phelps, M.E.; Kuhl, D.E.; Mazziotta, J.C. (Univ. of California, Los Angeles). *Science ;* **211**: 1445-1448(27 Mar 1981).

These studies demonstrated increasing glucose metabolic rates in the human primary (PVC) and associative (AVC) visual cortex as the complexity of visual scenes increased. The metabolic response of the AVC increased more rapidly with scene complexity than that of the PVC, indicating the greater involvement of the higher order AVC for complex visual interpretations. Increases in local metabolic activity by as much as a factor of 2 above that of control subjects with eyes closed indicate the wide range and metabolic reserve of the visual cortex.

17516 **Repair of the ultraviolet-irradiated male genome in fertilized mouse eggs.** Brandriff, B.; Pedersen, R.A. (Univ. of California, San Francisco). *Science ;* **211**: 1431-1433(27 Mar 1981).

Unscheduled DNA synthesis occurred in both male and female pronuclei of the mouse zygote in response to irradiation with ultraviolet light, indicating a capacity for excision repair. Furthermore, damage to DNA of the male gamete before fertilization can be repaired after the sperm enters the egg cytoplasm.

17517 **Oxygen isotope ratios in trees reflect mean annual temperature and humidity.** Burk, R.L.; Stuiver, M. (Univ. of Washington, Seattle). Contract AT06-79EV10206. *Science ;* **211**: 1417-1419(27 Mar 1981).

Values of the oxygen isotope ratios ($\delta^{18}O$) in tree-ring cellulose closely reflect the $\delta^{18}O$ values in atmospheric precipitation and hence mean annual temperature. The change in $\delta^{18}O$ in cellulose is 0.41 per mil per degree Celsius for selected near-coastal stations. The values of $\delta^{18}O$ in precipitation and cellulose also change with altitude, as demonstrated for Mount Rainier, Washington. A temperature lapse rate of 5.2° per 1000 meters calculated from cellulose $\delta^{18}O$ values agrees with the accepted mean annual lapse rate of 5°C per 1000 meters for this region.

17518 **Cell cycle kinetics in human lymphocyte cultures.** Morimoto, K.; Wolff, S. (Univ. of California, San Francisco). *Nature (London) ;* **288**: No. 5791, 604-606(11 Dec 1980).

Short-term cultures of phytohaemagglutinin (PHA)-stimulated human lymphocytes are widely used to detect chromosome-damaging agents, possible human exposure to mutagenic carcinogens and the immune response of blood. Because the results are affected by the number of cell divisions before sampling, an accurate knowledge of lymphocyte proliferation in culture is essential for these studies. In experiments combining sister chromatid differential staining and autoradiography, we show here that ^{3}H-TdR labelling at more than 0.1 μCi ml^{-1} slows lymphocyte cycling, and that the heterogeneity of different generations of cells is caused by a difference in the times when they start their first DNA synthesis in response to PHA.

17519 **Thyroid hormone modulation of x-ray-induced in vitro neoplastic transformation.** Guernsey, D.L.; Ong, A.; Borek, C. (Columbia Univ., New York, NY). *Nature (London) ;* **288**: No. 5791, 591-592(11 Dec 1980).

The direct oncogenic potential of x rays has been demonstrated by the in vitro neoplastic transformation of mammalian cells in culture, a technique which permits the study of oncogenesis in the absence of host-specific effects. Although several agents are known to modulate in vitro neoplastic transformation by X rays, little is known of the effects of hormones. We now describe experiments which show that the presence of thyroid hormone is necessary for in vitro neoplastic transformation by X rays in cells of an established mouse fibroblast culture and in early passage diploid hamster embryo cells.

17520 **Nutritional and protective properties of thiocystine.** Wood, J.L. (Univ. of Tennessee, Memphis). *Proceedings of the Society for Experimental Biology and Medicine ;* **165**: No. 3, 469-472(Dec 1980).

Some biological properties of thiocystine (bis[2-amino-2-carboxyethyl]trisulfide), a persulfide analog of cystine, have been investigated. Thiocystine replaced cystine in supporting growth of young rats fed a low-fat, low methionine diet. When injected intravenously into adult rats, thiocystine protected against two to three times in LD_{50} dose of intraperitoneal sodium cyanide. Thiocystine exhibited marginal activity for protecting mice against lethal x-ray irradiation. The biological properties of thiocystine can be attributed to its conversion in vivo to cystine and a persulfide sulfur moiety.

17521 **DNA repair in a short- and a long-lived rodent species.** Hart, R.W. (Ohio State Univ., Columbus); Sacher, G.A.; Hoskins, T.L. *Journal of Gerontology ;* **34**: No. 6, 808-817(1979).

Previous studies have reported a direct correlation between the rate of uv-induced unscheduled DNA synthesis and the maximum lifespan for seven mammalian species drawn from five different orders. We now examine this correlation in laboratory populations of two rodent species, the house mouse, Mus musculus, and the white-footed mouse, Peromyscus leucopus, both in the superfamily Muroidea. These species are similar in body size but Peromyscus exceeds Mus in lifespan by a factor of 2.5, as determined by live table studies in the same laboratory environment. The extent of

uv-induced unscheduled DNA synthesis by third-passage primary fibroblast cell cultures was measured for these two species, and the rate of DNA synthesis was 2.5 times greater for the Peromyscus cells, consistent with the greater lifespan of Peromyscus and with the relationship of repair of uv damage to lifespan found previously among representatives of five orders of mammals. A determination of patch size (size of the repair regions) by bromouracil photolysis following ultraviolet irradiation revealed that the patch sizes were the same for the two species, and that the number of repaired sites was 2.2 times greater for Peromyscus than for Mus, in agreement with the ratio found by measurement of unscheduled DNA synthesis. The number of single strand breaks induced by gamma rays, and the rate of rejoining of these breaks, as measured on alkaline sucrose gradients, were not significantly different in the two species.

17522 **Photoreactivation of pyrimidine dimers in DNA from thyroid cells of the teleost, Poecilia formosa.** Achey, P.M.; Woodhead, A.D.; Setlow, R.B. (Univ. of Florida, Gainesville). *Photochemistry and Photobiology ;* **29**: 305-310(1979).

We have developed and used a simple technique to estimate the quantity of pyrimidine dimers in unlabeled cellular DNA. DNA is extracted from cells, treated with an endonuclease specific for dimers, and its molecular weight estimated by its electrophoretic mobility on alkaline agarose slab gels. The technique is used to show that cells from thyroid tissue of the fish Poecilia formosa have photoreactivating activity towards dimmers in the cellular DNA.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 16855, 17444

17523 **(PB—80-209976) Fish community studies in the Patuxent estuary, 1978-79. Final report, April 1976-March 1979.** Homer, M.; Jones, P.W.; Bradford, R. Jr.; Mihursky, J.A. (Maryland Univ., Solomons (USA). Chesapeake Biological Lab.). Nov 1979. 325p. NTIS, PC A14/MF A01.

This report summarizes qualitative results of a one-year data collection program near the Chalk Point Power Plant. Some qualitative differences in abundance were measured, but no major effects could be attributed to the power plant effluent.

17524 **(PNL—3409) Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station.** Cushing, C.E.; Onishi, Y.; Simmons, M.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1981. Contract AC06-76RL01830. 32p. NTIS, PC A03/MF A01.

Toledo Edison Company's Bay Shore steam electric generation station in Oregon, Ohio, discharges effluents into nearby Maumee Bay. Demonstration report 316(a) by WAPORA (1977) analyzed the impacts of thermal discharge on Maumee Bay, and demonstration report 316(b) by Reutter et al (1978) analyzed the impact of entrainment and impingement on fish communities. Pacific Northwest Laboratory assessed these two reports. We generally agree with WAPORA (1977) on the impact of thermal effluents on the Maumee Bay ecosystems. Our computations indicated temperature increases which would result in larger areas of isotherms, but these increases were insignificant in terms of the percent of the area of Maumee Bay affected. We basically agree with Reutter et al (1978) conclusions concerning impingement and entrainment losses at Bay Shore Station. Our calculations indicate that the impingement data presented in Reutter et al (1978) are accurate estimates based on their sampling program. Their 95% confidence limits for less frequently caught species of fish, however, are too conservative.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 16854, 16855, 17199, 17369, 17371, 17452, 17502, 17513, 17524

17525 **(BNL—29064) Urinary metallothionein as a biological indicator of occupational cadmium exposure.** Tohyama, C.; Shaikh, Z.A.; Ellis, K.J.; Cohn, S.H. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics; Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 9p. (CONF-810238—1). NTIS, PC A02/MF A01.

From 3. international cadium conference; Miami, FL, USA (3 Feb 1981).

Radioimmunoassay and neutron activation data indicate that the urinary metallothionein concentration is related to the liver Cd concentration in occupational Cd exposure. It is also related to the kidney Cd content - but only before the onset of renal dysfunction. Further epidemiological studies are needed to establish a dose-response relationship, which may be useful in minimizing the hazard of Cd-induced renal dysfunction.

17526 **(BNL—29066) Critical organ concentration of cadmium in occupationally-exposed workers.** Ellis, K.J.; Morgan, W.D.; Yasumura, S.; Vartsky, D.; Zanzi, I.; Cohn, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 16p. (CONF-810238—2). NTIS, PC A02/MF A01.

From 3. international cadium conference; Miami, FL, USA (3 Feb 1981).

This report describes the present Brookhaven facility for in vivo measurements of cadmium in man and provides a comparison with other portable systems. The cadmium detection limits are 2.2 mg in the kidney and 1.5 ppM in the liver for the Brookhaven system. In a recent field study, the cadmium content of the left kidney and concentration in the liver were measured in 82 occupationally exposed workers and 10 control subjects. Organ content ranged up to 57 mg in the kidney and up to 120 ppM in the liver for the industrial group. By contrast, the values for the control group ranged from 0.4 to 11.8 mg for the kidney and 0.7 to 7.9 ppM for the liver. The geometric means were 3.7 mg for the kidney and 2.7 ppM for the liver in the control group. When the data were analyzed to provide an estimate of the critical concentration for the kidney, a range of 300 to 400 $\mu g/g$ for the renal cortex was calculated. The corresponding cadmium concentrations in the liver and urine were 30 to 42 ppM (liver) and 22 to 28 $\mu g/g$ creatinine (urine), respectively. Blood and urine levels of cadmium and β_2-microgloubin were also evaluated as possible biological indicators of organ content.

17527 **(BNL—29097) Considerations of an air-quality standard to protect terrestrial vegetation from acidic precipitation.** Evans, L.S. (Manhattan Coll., New York (USA). Lab. for Plant Morphogenesis; Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 23p. (CONF-810131—1). NTIS, PC A02/MF A01.

From California symposium on acid precipitation; San Francisco, CA, USA (13 Jan 1981).

Studies on the effects of acidic precipitation which is here defined as wet or frozen deposition with a hydrogen ion concentration greater than 2.5 $\mu eq\ l^{-1}$, are reviewed. At the present time there is an inadequate amount of information that shows decreases in crop growth except for one field study. Most studies with plants (crops and forests) are inadequate for standard setting because they are not conducted in the field with adequate randomization of plots coupled with rigorous statistical analyses. Although visible injury to foliage has been documented in a variety of greenhouse studies, no experimental evidence demonstrates loss of field crop value or reduction in plant productivity due to visible foliar injury. Acidic precipitation can contribute nutrients to vegetation and could also influence leaching rates of nutrients from vegetation. Although these processes occur, there are no data that show changes in nutrient levels in foliage that relate to crop or natural ecosystem productivity. Experimental results show that fertilization of ferns is inhibited by current levels of acidic precipitation in the northeastern United States. However, the overall impacts of inhibited fertilization on perpetuation of the species or ecosystem productivity have not been evaluated. Simulated acidic precipitation has been shown to effect plant pathogens in greenhouse and field experiments. Sim-

ulated acidic precipitation inhibited pathogen activities under some circumstances and promoted pathogen activities under other circumstances. No conclusion can be drawn about the effects of current levels of precipitation acidity on plant pathogen-host interactions. From these data it must be concluded that research on the effects of acidic precipitation on terrestrial vegetation is too meager to draw any conclusions with regard to an air quality standard.

17528 **(BNL—29259) Genetic effects of ethylene dibromide in Drosophila melanogaster.** Kale, P.; Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016;AS02-78EV04733. 13p. (CONF-810219—2). NTIS, PC A02/MF A01.

From Symposium on the genotoxic effects of airborne agents; Upton, NY, USA (Feb 1981).

Drosophila, an organism known to be one of the best among the available systems for mutation detection, can be used for detecting very low concentrations of airborne mutagens. Using ethylene dibromide (EDB), it was demonstrated that Drosophila could detect concentrations as low as 0.2 ppM in air when exposed for a relatively short period of 11 hrs. The exposure period can be prolonged to as many as 700 hrs using Drosophila. Response was proportional to integrated exposure in ppM-hr at low exposure values. It is, therefore, possible to detect airborne mutagens in the parts per billion range using proper germ cell stages in this system. Drosophila may, therefore, be used as a biological monitor to detect mutagenicity of air in polluted areas. Thus, the system may complement Tradescantia, another sensitive system being used for this purpose. Ethylene dibromide was selected as a test chemical in these studies since its mutagenic properties had previously been demonstrated in Drosophila and in Tradescantia. In Tradescantia, extensive data on the dose vs. mutation relation were available and these data were considered useful in evaluating the comparative sensitivity of the two systems for detecting airborne mutagens.

17529 **(CONF-810350—1) LA-UR—81-859.** Walters, R.A.; Enger, M.D.; Hildebrand, C.E.; Griffith, J.K. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01.

From ICN-UCLA symposium on molecular and cellular biology; Keystone, CO, USSR (15 Mar 1981).

Three variant cell lines were isolated which survive cadmium (Cd^{++}) concentrations 10 to 200 fold greater than that which kills parental Chinese hamster cells (line CHO). Cadmium treatment of the variants induces the synthesis of a highly abundant poly A^+ RNA class which directs the synthesis of metallothionein in a cell-free translation system. Hybridization of cDNA complementary to these inducible, highly abundant RNA sequences (cDNA/sub a/) with RNA from variant cells showed that: (1) the induced abundant class has a total complexity of ~ 2000 NT; (2) CD^{++} induction increases the cellular concentration of these sequences ~ 2000 fold above preinduction levels in each of the variants; and (3) most, if not all, of these sequences are expressed constitutively in uninduced cells. Cadmium induction of sensitive CHO cells increases the cellular concentration of only a subset of the sequences inducible in resistant cells and then only to a level 100 fold higher than in uninduced cells. Only ~ 50% of the sequences are constitutively expressed at measurable levels in uninduced CHO cells. Hybridization of cDNA/sub a/ with genomic DNA from the three resistant variants showed that genes coding for the induction of specific RNA sequences are amplified ~ 10 fold in Cd/sup r/20F4 cells, ~ 4 fold in Cd/sup r/30F9 cells, and unamplified in Cd/sup r/2C10 cells relative to CHO. While sensitive CHO cells can tolerate only 0.2 μM Cd^{++}, Cd/sup r/30F9, Cd/sup r/20F4, and Cd/sup r/2C10 cells are resistant to 40 μM, 26 μM, and 2 μM Cd^{++} respectively. Thus, gene amplification alone cannot be responsible for the observed resistance of the variant cell lines.

17530 **(CONF-810428—(Absts.)) Symposium on molecular and cellular mechanisms of mutagenesis.** (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01.

From Symposium on molecular and cellular mechanisms of mutagenesis; Gatlinburg, TN, USA (6 Apr 1981).

These proceedings contain abstracts only of the 21 papers presented at the Sympsoium. The papers dealt with molecular mechanisms of mutagenesis and cellular responses to chemical and physical mutagenic agents. (ERB)

17531 **(DOE/EV/02412—105) Ecological behavior and effects of energy-related pollutants. Progress report, November 1, 1979-January 31, 1981.** Ragsdale, H.L.; Murdy, W.H. (Emory Univ., Atlanta, GA (USA). Dept. of Biology). Jan 1981. Contract AS05-76EV02412. 58p. NTIS, PC A04/MF A01.

Research progress is reported for the period November 1979 through January 1981 in the following areas: definition of the stages of plant sexual reproduction most susceptible to SO_2 stress; the role of flower structure and function on the susceptibility of sexual reproduction to SO_2 stress; and the effects of the SO_2-NO_2 combination on plant sexual reproduction. (ACR)

17532 **(DOE/EV/03017—43) Radiation carcinogenesis. Comprehensive final report, 16 May 1979-31 December 1980.** Warren, S.; Brown, C.E.; Gates, O. (New England Deaconess Hospital, Boston, MA (USA). Cancer Research Inst.). Mar 1981. Contract AS02-76EV03017. 29p. NTIS, PC A03/MF A01.

This abstract covers three main areas of investigation: mesothelioma induction by asbestos, radiation tumorigenesis and transplantable tumors. Canadian and Rhodesian asbestos fibers have been administered under anesthesia to rats by intratracheal, intrapleural and intraperitoneal injection. Additional groups were given 3-methylcholanthrene or x-radiation along with asbestos. A large series of mice also treated as above have displayed mesotheliomas. In addition, glass fiber injections and feeding of asbestos were done and have produced negative results to date. The carcinogenic effect of whole-body radiation on hemi-irradiated parabiont partners exposed to a single 1000 R dose of x-ray was evidenced by a significant increase in the incidence of malignant tumors in only six tissues: skin, supporting soft tissue, kidney, bone, pancreatic islets and ovary. In the male adrenal medulla and in the female breast genetic and parabiotic hormonal factors were judged to exert a significant effect. The occurrence of incisional (anastomotic) sarcomas in significant numbers in hemi-irradiated and parabiont control pairs suggests the operation of mechanical factors complicating the healing process, only slightly enhanced by radiation. One of the very valuable but unanticipated developments of the rat radiation program was the isolation of two transplantable endocrine tumors with strong hormonal potentials: an insulinoma of the pancreas and a pheochromocytoma of the adrenal medulla.

17533 **(LMF—77) Low-Btu-gasifier emissions toxicology. Status report, June 1980.** Newton, G.J. (ed.). (Inhalation Toxicology Research Inst., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76EV01013. 36p. NTIS, PC A03/MF A01.

The major goal of this research effort is to assess inhalation hazards to plant workers and the general population that may be associated with low Btu coal gasification. Secondary goals are characterization of potential toxicants in liquid and solid process and waste streams. To these ends, the experimental low Btu gasifier at METC has been sampled to determine aerosol components in gaseous process streams and to assess potential toxicants in liquid and solid effluent streams with the most recent sampling effort in December 1979. Although this report concentrates on results obtained from December 1, 1979, to June 1, 1980, the following summary is intended to organize all data to date and draw tentative hypotheses which will be subjected to further testing in future sampling and analysis efforts. Diluting and/or cooling low Btu producer gas, as would happen in fugitive releases, produces a dense, respirable aerosol. Toxic element concentrations are higher in aerosols from clean gas than from raw gas streams at METC. Gasifier operating conditions have little effect on the elemental composition of cleaned gas aerosols.

17534 **(PB—80-210552) Biochemical effects of inhalation of sulfuric acid mist by human subjects while at rest. Report for 15 January-1 May 1979.** Chaney, S.; Blomquist, W.; Muller, K.; DeWitt, P. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Oct 1979. 29p. NTIS, PC A03/MF A01.

A total of 20 human subjects were exposed to 100 micrograms/cu m (0.033 uM) sulfuric acid aerosol (0.5 micrometers mean mass diameter) for four hours per day for two consecutive days. A total of 17 human subjects were exposed to four hours of ambient air on both exposure days. The subjects were at rest during both exposures. Seven biochemical blood parameters were measured pre and post exposure and 20 hours after the second exposure: serum glutathione, red blood cell glutathione reductase, red blood cell glucose-6-phosphate dehydrogenase, lysozyme, serum glutamic oxaloacetic acid transaminase, serum vitamin E and 2,3-diphosphoglycerate. The results indicate no significant response in any of the seven biochemical blood parameters measured.

17535 **(UR—3490-1883) In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs.** Coombs, M.A. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1980. Contract AC02-76EV03490. 205p. NTIS, PC A10/MF A01. Thesis.

The distribution of carrier free lead-203 between plasma and cells of canine blood in vitro was measured. Activity in the plasma decreased to less than 5% of the initial blood activity during the first 15 min and then exponentially with a half time of 160 min. Incubation in cell free plasma before addition to whole blood transformed the isotope, decreasing the amount subsequently associated with cells. In animal studies, activity was measured in plasma, blood cells, urine, and feces after exposure to lead-203. In one group, the animals were exposed by intravenous injection of dilute citric acid solutions of isotope. In a second group, carrier free isotope which had been transformed by incubation in plasma was injected intravenously. The kinetics of the distribution of the isotope differed between the two experimental groups. After injection of the transformed lead, the lead-203 content of the blood cell fraction rose from 10% of the dose at 5 min to 21% to 43% at 13 h. The red cell activity after injection of citric acid solutions of lead-203 remained between 50 and 60% of the dose from 5 min to 12 h post exposure. Excretion of lead in the urine during the first day after injection of transformed lead ranged from 5 to 45% of the dose, while that of citric acid solutions of lead was between 1 and 2%. Linear compartmental models for distribution of the isotope were developed for both in vitro and in vivo experimental systems. In three additional experiments, animals were exposed to lead-203 extravascularly. In one, using a dilute citric acid solution of the isotope, plasma activity resembled that observed after intravenous injection, suggesting that isotope was transformed by extravascular fluids before reaching the circulation. In the two remaining experiments the animals were exposed to lead-203 by gavage. The results suggest that lead absorbed from the gut may have been transformed before reaching the circulation. (ERB)

17536 **Phenobarbital effects on weight gain and circadian cycling of food intake and body temperature.** Peraino, C.; Ehret, C.F.; Groh, K.R.; Meinert, J.C.; D'arcy-Gomez, G. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Proceedings of the Society for Experimental Biology and Medicine ;* **165**: No. 3, 473-479(Dec 1980).

Rats fed a diet supplemented with phenobarbital at a concentration of 0.25% gained less weight than rats fed the unsupplemented diet. The reduced weight gain in the phenobarbital-treated rats accompanied the induction of marked hepatomegaly. Circadian cycling of food consumption in control rats followed a biphasic pattern, with the first feeding episode occurring during the middle of the 12-h dark phase and the second occurring as the dark phase ended. In rats on phenobarbital, eating activity was confined to the first feeding episode, with the level of intake during this interval increasing to compensate for the absence of significant subsequent feeding, so that the daily levels of food consumption were similar in both groups. Measurements of circadian cycling of deep body temperature showed that ingestion of 0.25% dietary phenobarbital approximately doubled the amplitude of the temperature cycle and advanced the time at which peak temperature was attained by aproximately 2 h. It is suggested that the lower weight gain in rats chronically exposed to 0.25% dietary phenobarbital results primarily from alterations in hepatic metabolism, but phenobarbital-mediated changes in the circadian cycling of food intake and deep-body temperature may also contribute to the growth reduction.

17537 **Mutagenicity of soot and associated polycyclic aromatic hydrocarbons to Salmonella typhimurium.** Kaden, D.A.; Hites, R.A.; Thilly, W.G. (Massachusetts, Inst. of Tech., Cambridge). *Cancer Research ;* **39**: 4152-4159(Oct 1979).

The mutagenic activity of the polycyclic aromatic hydrocarbon-containing fraction of several soot samples was measured in Salmonella typhimurium, using resistance to the purine analog 8-azaguanine as a genetic marker. A postmitochondrial supernatant derived from livers of phenobarbital- and/or Aroclor-pretreated male Sprague-Dawley rats was incorporated into all assays to allow metabolism of promutagens to their active forms.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 16855

17538 **(CONF-801187—(Absts.)) Project resumes: biological effects from electric fields associated with high-voltage transmission lines.** (Department of Energy, Washington, DC (USA)). 1980. 40p. NTIS, PC A03/MF A01.

From Contractors review on biological effects from electric fields associated with high voltage transmission lines; Washington, DC, USA (18 Nov 1980).

Abstracts of research projects are presented in the following areas: measurements and special facilities; cellular and subcellular studies; physiology; behavior; environmental effects; modeling, scaling and dosimetry; and high voltage direct current. (ACR)

17539 **(PB—80-211212) Nonionizing electromagnetic radiation safety: a program of coordinated federal activities related to biological effects of nonionizing electromagnetic radiation (0-300ghz).** (National Telecommunications and Information Administration, Washington, DC (USA)). Dec 1979. 90p. NTIS, PC A05/MF A01.

The report describes a program for coordinated Federal activities on nonionizing electromagnetic radiation (NER) safety. The program seeks to develop a better understanding of biological effects and interactions of NER through identification of several program objectives: determine population exposure (environmental, occupational, consumer and medical); determine energy absorbed; determine biological consequences of exposure; develop instrumentation and exposure systems; conduct assessments of risk and impact; and recommend control measures.

17540 **(JPRS—77393) USSR report: life sciences. Effects of nonionizing electromagnetic radiation, No. 3.** (Joint Publications Research Service, Arlington, VA (USA)). 13 Feb 1981. Translation of various articles. 61p. NTIS.

This serial report contains articles, abstracts of articles and news items from USSR scientific and technical journals on the effects of nonionizing electromagnetic radiation on organisms and biological tissues. In all, 21 items are included.

17541 **Preliminary environmental assessment for the satellite power system (SPS).** *Journal of Environmental Sciences ;* **24**: No. 1, 16-22, 31-32(Jan 1981).

The health, safety, and environmental impacts of collecting solar energy in space, converting it to microwave energy, transmitting a microwave beam to earth, and then converting the microwave power to electricity are discussed in this article. The SPS microwave power transmission system would generally expose people and the environment to low levels of microwave radiation. There is evidence that microwave radiation can effect the immune and blood systems of animals if the rate of heat absorbed exceeds the animal's basal metabolic rate. It can also produce structural changes in the genes if the intensity is such that cells are substantially heated. Data regarding the cancer-producing potential of microwaves are inconclusive. Behavioral changes have been observed in laboratory animals exposed to microwave radiation. The non-microwave health and environmental considerations in the development of SPS are also considered. SPS effects on the atmosphere are discussed. Ionospheric disturbances on telecommunications are also considered. SPS microwave transmission represents a source of potential interference to many types of electronic and electrical instruments under a wide range of rectinnal siting situations. (RJC)

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 17305, 17422, 17451, 17452

17542 (BNL—51313) Marshall Islands: a study of diet and living patterns. Naidu, J.R.; Greenhouse, N.A.; Knight, G.; Craighead, E.C. (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH00016. 76p. NTIS, PC A05/MF A01.

This study summarizes information on diet and living patterns for the Marshallese. The data was derived from literature, answers to questionnaires, personal observations while living with the Marshallese for periods extending from months to years, and from direct participation in their activities. The results reflect the complex interactions of many influences, such as, the gathering of local foods the receipt of food aid through programs, such as, schoollunch, typhoon-relief, food distributed to populations displaced as a result of nuclear testing, and in recent times the availability of cash for the purchase of imported foods. The results identify these influences and are therefore restricted to local food diets while recognizing that the living patterns are changing as local food gathering is replaced by other food supplies. The data will therefore provide the necessary information for input into models that will assess the radiological impacts attributable to the inhabitation of the Marshall Islands. It is recommended that this study should be continued for at least two to three years in order to more accurately identify trends in local food consumption and living patterns.

58 GEOSCIENCES

5801 Geology And Hydrology

17543 (DP-MS—80-131) Well data file at the Savannah River Plant. Krapp, C.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1981. Contract AC09-76SR00001. 17p. (CONF-810336—1). NTIS, PC A02/MF A01.

From South Carolina Academy of Sciences meeting; Columbia, SC, USA (26 Mar 1981).

Information on more than 5000 wells drilled on the Savannah River Plant, Aiken, SC, has been centralized in a computer-based file. The Well Data File includes information on the location, construction, geology, water level, yield, and current status of the wells, and the location of additional information in paper files. This computer file is a valuable resource when planning new facilities, making environmental assessments, applying for state and federal permits, and performing geological and hydrological studies. Outputs of file queries are either a one-page written summary for each well or a map of well locations.

17544 (ORNL/TM—7289) White Oak Creek Watershed topographic map and related materials. Farrow, N.D. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01.

On March 22, 1978 a contract was let to Accu-Air Surveys, Inc., of Seymour, Indiana, to produce a topographic map of the White Oak Creek Watershed. Working from photography and ground control surveys, Accu-Air produced a map to ORNL's specifications. The map is in four sections (N.W., N.E., S.W., S.E.) at a scale of 1:2400. Contour intervals are 5 ft (1.5 m) with accented delineations every 25 ft (7.6 m). The scribe method was used for the finished map. Planimetric features, roads, major fence lines, drainage features, and tree lines are included. The ORNL grid is the primary coordinate system which is superimposed on the state plain coordinates.

17545 (RHO-BWI-C—87) Review of the upper Cenozoic stratigraphy overlying the Columbia River Basalt Group in western Idaho. Strowd, W.B. (Idaho Bureau of Mines and Geology, Moscow (USA). Dept. of Lands). Dec 1980. Contract AC06-77RL01030. 87p. NTIS, PC A05/MF A01.

This report is a synthesis of information currently available on the rocks that stratigraphically overlie the Columbia River Basalt Group in Idaho. The primary objective is to furnish a brief but comprehensive review of the literature available on upper Cenozoic rocks in western Idaho and to discuss their general stratigraphic relationships. This study also reviews the derivation of the present stratigraphy and notes weaknesses in our present understanding of the geology and the stratigraphy. This report was prepared in support of a study to evaluate the feasibility of nuclear waste storage in the Columbia River Basalt Group of the Pasco Basin, Washington.

17546 Paleochemistry of Plio-Pleistocene Lake Turkana, Kenya. Cerling, T. (Univ. of California, Berkeley). Contract W-7405-ENG-26. *Palaeogeography, Palaeoclimatology, Palaeoecology ;* **27**: 247-285(1979).

The paleochemisry of Plio-Pleistocene Lake Turkana can be estimated by using the chemistry of lakes from the Eastern Rift of Africa as an analogue. Most modern East Africa lakes occupy closed basins; their chemistries follow an evaporation trend defined by the precipitation of certain mineral phases with increasing alkalinity. Estimates of paleoalkalinity can be used to closely estimate the chemical composition of ancient lakes. Three methods are used to estimate paleoalkalinity. Diatoms, molluscs, and fish have certain metabolic requirements that are dependent on pH, alkalinity, or calcium levels; thus fauna and flora can be used as paleoalkalinity indicators. Exchangeable cations on clay minerals can also be used because the relative concentrations of sodium and calcium in lake waters are related to alkalinity. Absence or presence of certain minerals also can serve as a paleoalkalinity indicator. Although the latter two techniques give estimates of paleoalkalinity that are averaged over several hundred or thousand years, their estimates agree with the instantaneous estimates based on biologic considerations. This study shows that the earliest lake phase was very fresh and contained until the end of the Kubi Algi Formation. The Lower Member of the Koobi Fora Formation is shown to have been a fresh- to brackish-water lake. From the beginning of Upper Member time (about 1.8 MY ago) to the present, the lake occupying the Turkana Depression has varied from a brackish lake that overflowed to a closed basin lake that fell below overflow level and whose alkalinity rose to about 200 meq/l.

5802 Geophysics

REFER ALSO TO CITATION(S) 16421, 16741

17547 (DOE/ID/12079—25) IPINV: a two-dimensional dipole-dipole resistivity modeling and inversion program. User's guide and documentation for Rev. 1. Tripp, A.C.; Killpack, T.J. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jan 1981. Contract AC07-79ID12079. 52p. NTIS, PC A04/MF A01.

IPINV.REV1 is a batch program that is capable of inverting resistivity data to two-dimensional models for a dipole-dipole array. The forward problem is computed using a transmission surface analogy. IPINV.REV1 is capable of inverting resistivity data to two-dimensional models of arbitrary complexity. The two-dimensional forward modeling routine is based on the transmission surface analogy (Madden, 1972). The inversion algorithm is a linearized least-squares technique. Step-size stabilization is provided by either the Box-Kanemaesu (1972) method or by using a Marquardt step. The program uses log derivatives to increase the rate of convergence.

17548 (DOE/ID/12079—26) Terrain correction program for gravity data: user's guide and documentation for Rev. 0). Serpa, L.F.; Cook, K.L. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jan 1981. Contract AC07-79ID12079. 12p. NTIS, PC A02/MF A01.

Terrain accesses terrain data stored on a magnetic tape to create terrain maps digitized at 30 sec., 1 min., and 3 min. of arc intervals of the area to be used for the terrain corrections. This report presents a program description and a sample execution of the program. (ACR)

17549 (FOA-C—20295-E4) Swedish earthquakes and acceleration probabilities. Slunga, R. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1979. 48p. NTIS (US Sales Only), PC A03/MF A01.

A method to assign probabilities to ground accelerations for Swedish sites is described. Intensity and radius of perceptability are transformed to a seismic strength measure (magnitude measure) and focal depth. This transformation is based on wave propagation computations for a realistic crustal model. Most Swedish earthquakes have a focal depth less than 25 km. The theoretical wave propagation computations also give the distance dependence of the elastic waves radiated by the earthquake sources. Basic idea in the probability computation is the assumption of uniform distribution of epicenters. This uniform distribution is estimated in a systematically conservative manner for each site. For the nuclear power plant sites an annual probability of 10^{-5} has been proposed as interesting. This probability gives ground accelerations in the range 5 to 20% for the sites. This acceleration is for a free bedrock site. For consistency all acceleration results in this study are given for bedrock sites. For the 1904 earthquake the epicental acceleration of 5 to 15% g was found. The results above are based on an analyses of macroseismic data as relevant instrumental data is lacking. However, the macroseismic acceleration model deduced in this study gives epicentral ground acceleration of small Swedish earthquakes in agreement with existent distant instrumental data. 19 figures, 2 tables.

17550 **Possible terrestrial volcanic occurrences of gas clathrate hydrates.** Gaffney, E.S. (Los Alamos Scientific Laboratory, Los Alamos, NM 87545). *Geophysical Research Letters ;* **8**: No. 1, 51-54(Jan 1981).

On the basis of the thermodynamic stability of hydrates of SO_2, H_2S and CO_2, it is suggested that those compounds may be found in some terrestrial volcanic environments. Hydrates of SO_2 and H_2S may be found in low-temperature fumaroles, especially where surrounding rocks are below 0 °C. Such situations could occur at high altitudes and/or high latitudes. Hydrates of H_2S, SO_2, and CO_2 may be found on grain surfaces and in pore spaces of pyroclastic or other material overlying gas sources where proper conditions prevail, such as pore pressure equal to overburden pressure. For H_2S, such deposits can occur with mean surface temperatures as high as 20 °C. Submarine volcanism could give rise to stable submerged hydrate occurrences analogous to both the above occurrences.

17551 **Rupture zones of great earthquakes in the Alaska-Aleutian arc, 1784 to 1980.** Sykes, L.R. (Columbia Univ., New York, NY); Kisslinger, J.B.; House, L.; Davies, J.N.; Jacob, K.H. *Science ;* **210**: 1343-1345(19 Dec 1980).

Historical documents indicate that great earthquakes ruptured at least a 500-kilometer-long segment of the plate boundary near the Alaska Peninsula in 1788 and 1847. At least half of a major seismic gap in the Shumagin Islands ruptured during those shocks but has not experienced a great earthquake for at least 77 years. Large shocks along this and other plate boundaries occur in bursts followed by several decades during which there is very little energy release.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 16428, 16562

17552 **(ONWI—104) Creep of 50-mm diameter specimens of dome salt from Avery Island, Louisiana.** Hansen, F.D.; Mellegard, K.D. (RE/SPEC, Inc., Rapid City, SD (USA)). Aug 1980. Contract AC06-76RL01830. 268p. NTIS, PC A12/MF A01.

This report describes triaxial compression creep experiments performed on domal salt from Avery Island, Louisiana. The ranges of axial stress difference $\Delta\sigma$, confining pressure $\sigma 2$, and temperature T studies covered those expected in a nuclear waste repository: $6.9 \leqq \Delta\sigma \leqq 31.0$ MPa, $0 \leqq \sigma 2 \leqq 20.7$ MPa, $24°C \leqq T \leqq 200°C$. All specimens exhibited transient creep, and the strain data were fitted to a constitutive law of the form ϵ = kt/sup n/$\Delta\sigma$/sup m/T/sup p/. The duration of some experiments was long enough for the specimen to reach steady-state. An activation energy for the rate-controlling deformation mechanism was calculated using data from these experiments. Finally, creep of Avery Island and Jefferson Island domal salts were compared and found to be similar.

17553 **(ORNL/TM—7695) Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee.** Sledz, J.J.; Huff, D.D. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 150p. NTIS, PC A07/MF A01.

Thesis. Submitted by J.J. Sledz to Univ. of Tennessee, Knoxville.

Joint orientations for the shale and siltstone beds of the Conasauga Group were measured from outcrop exposures on the Oak Ridge National Laboratory Reservation. The data collected from two strike belts (structural trends) were analyzed with the use of the computer and subdivided into individual joint sets. The joint set patterns in the Northern outcrop belt were too complex for orientation prediction; joint formation is believed to be influenced by polyphase deformation. The Southern Conasauga Belt contains an orthogonal joint set consisting of strike and a-c joints in all outcrops measured. These are believed to be tension joints formed during thrust sheet emplacement. Joint length and spacing, measured in the field, were found to be extremely variable within each exposure and highly dependent upon surficial weathering. The measurements from all locations were combined for detailed analysis and trend prediction. Results showed that the joint length and spacing increased with increasing bed thickness in the siltstone, while the bed thickness variations in the shale had little effect on the joints. A computer model was developed by combining the joint orientation, joint spacing, and joint length data collected in the field with subsurface drill core information for the purpose of calculating the fracture porosity and permeability of the rocks. The joint gap width was measured from both outcrop and subsurface samples with ranges from 0.1 mm to 0.7 mm in the siltstones and less than 0.2 mm in the shales. The value for the joint gap width was found to be the major factor in the fracture porosity and permeability calculation.

17554 **(UCRL—83789(Rev.1)) Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature.** Durham, W.B.; Abey, A.E.; Trimmer, D.A. (Lawrence Livermore National Lab., CA (USA)). 4 Mar 1981. Contract W-7405-ENG-48. 14p. (CONF-791134—10(Rev.1)). NTIS, PC A02/MF A01.

From 16. international thermal conductivity conference; Chicago, IL, USA (7 Nov 1979).

Preliminary data on the thermal propertes of a coursegrained rock salt from Avery Island, Louisiana, indicate that hydrostatic pressure to 50 MPa has little effect on the thermal conductivity, diffusivity and linear expansion at temperatures from 300 to 573 K. The measurements were made in a new apparatus under conditions of true hydrostatic loading. At room temperature and effective confining pressure increasing from 10 to 50 MPa, thermal conductivity and diffusivity are constant at roughly 7 W/mK and $3.6 \times 10^{-6} m^2/s$, respectively. At 50 MPa and temperature increasing from 300 to 573 K, both conductivity and diffusivity drop by a factor of 2. Thermal linear expansion at 0 MPa matches that at 50 MPa, increasing from roughly $4.2 \times 10^{-5}/K$ at 300 K to $5.5 \times 10^{-5}/K$ at 573 K. The lack of a pressure effect on all three properties is confirmed by previous work. Simple models of microcracking suggest that among common geological materials the lack of pressure dependence is unique to rock salt.

5804 Geochemistry

REFER ALSO TO CITATION(S) 16463, 16464

5805 Oceanography

REFER ALSO TO CITATION(S) 17347, 17442, 17445

17555 **(DOE/EV/00889—7(Vol.1)) Continental shelf processes affecting the oceanography of the South Atlantic Bight. Progress report, 1 June 1980-1 June 1981.** Atkinson, L.P. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). Feb 1981. Contract AS09-76EV00889. 160p. NTIS, PC A08/MF A01.

Research progress is reported in studies of the oceanography of the South Atlantic Bight during the spring transition period. Volume I contains preliminary results of GABEX-I. (ACR)

17556 **(DOE/EV/00889—7(Vol.2)) First preliminary report of the GABEX-1 cruises: station logs, standard sections and maps and time series transects.** Atkinson, L.P.; Singer, J.J.; Chandler, W.S. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 8 Jul 1980. Contract AS09-76EV00889. 170p. NTIS, PC A08/MF A01.

Research progress is reported in studies of the oceanography of the South Atlantic Bight during the spring transition period. Volume II contains the preliminary cruise report.

17557 **(DOE/EV/00889—7(Vol.3)) Hydrographic observations off Savannah and Brunswick, Georgia: March, May and September 1977 and January 1978. Technical report 80-1.** Singer, J.J.; Atkinson, L.P.; Chandler, W.S.; Bishop, S.S. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1980. Contract AS09-76EV00889. 437p. NTIS, PC A19/MF A01.

Research progress is reported in studies of the oceanography of the South Atlantic Bight during the spring transition period. Volume 3 contains technical reports of hydrographic observations. (ACR)

17558 **Comments on "Bulk parameterization of air-sea exchanges of heat and water vapor including the molecular constraints at the interface" .** Wesely, M.L. (Radiological and Environmental Research Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of the Atmospheric Sciences ;* **37**: No. 12, 2798-2800(Dec 1980).

The surface-renewal theory of Liu, Katsaros, and Businger is compared to field data. (AIP)

64 PHYSICS RESEARCH

17559 **(JPRS—77389) East Europe report: scientific affairs, No. 694.** (Joint Publications Research Service, Arlington, VA (USA)). 13 Feb 1981. Translation of various articles. 35p. NTIS.

Scientific articles published in Hungary, Poland, Czechoslovakia, and Albania on the following subjects are translated into English: Hungarian-Soviet agriculture cooperation; neutron physics; laser research; integrated circuits; energy from manure; interferon production; social pathology; and research planning. (LCL)

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 17632, 17672, 17721

17560 **(DOE/ER/10423—T2) Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981.** Dehnhard, D. (Minnesota Univ., Minneapolis (USA)). Mar 1981. Contract AS02-79ER10423. 58p. NTIS, PC A04/MF A01.

Experiments performed at the Los Alamos Meson Physics Facility yielded very striking results. In inelastic pion scattering from ^{14}C near the [3,3] resonance cross sections ratios $R = \sigma(\pi^+)/\sigma(\pi^-)$ and $R^{-1} = \sigma(\pi^-)/\sigma(\pi^+)$ were observed that are significantly larger than the free pion-nucleon values. These results were interpreted as due to strong cancellations of the neutron and proton components in the transition amplitude. Measurements of $^{13}C(\pi,\pi')$ excitation functions between 100 and 300 MeV at two momentum transfers showed dramatically different energy dependencies for $\Delta S = 0$ and $\Delta S = 1$ transitions. They were used to derive nuclear structure information on several highly excited states. Pion data for other nuclei (^{12}C, ^{16}O, ^{40}Ca, etc.) were analyzed and information on isospin mixing, the double-charge-exchange reaction mechanism, and the excitation of collective states was extracted. Further data were taken with a 547 MeV proton beam on ^{13}C. The data taking for the (t,t') and (^3He,$^3He'$) reactions at the Los Alamos Van de Graaff has been completed. The continuing studies of the heavy-ion nucleus optical potential yielded information on very systematic dependencies of the potential depths on the incident energy.

17561 **(DOE/ER/10774—1) Very high energy gamma ray astrophysics. Progress report, August 1, 1980-July 31, 1981.** Lamb, R.C. (Iowa State Univ. of Science and Technology, Ames (USA)). Apr 1981. Contract AC02-80ER10774. 5p. NTIS, PC A02/MF A01.

Very high energy (VHE) gamma ray astronomy gives insight into fundamental questions regarding the origins of cosmic rays and the types of particle acceleration mechanisms which operate in nature. VHE photons are detected by means of the Cerenkov light their secondaries produce in the atmosphere. During June - September 1981 the solar collectors at Edwards Air Force Base will be used to detect the Cerenkov light from the photons from Cygnus X-3 thus extending its observation into a previously unexplored region. The time of each detector event will be recorded to the nearest 0.5 ms. If Cygnus X-3 is the neutron star remnant of a recent (unseen) supernova, then the VHE gamma rays may be pulsed at its rotation rate, and the data obtained will allow a sensitive test of this possibility. The equipment for the summer observations is nearly ready and will be tested in May prior to any early run in June.

17562 (SLAC—239, pp 601-615) **Neutrinos and cosmology.** Schramm, D.N. Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

To date, the interdisciplinary effort involving cosmologists, nuclear physicists and particle physicists has produced some exciting results. The ^4He abundance fixes an upper limit of eight quark flavors on models with quark/lepton symmetry and a baryon dominated universe. The grand unification ideas may resolve the puzzle of one baryon for every 10^{10} photons. If neutrinos have mass then the bulk of the mass of the universe may be in the form of leptons. As knowledge of the fundamental particles and their interactions increase, and as determination of cosmological observables improves (or new observables are discovered) the close relationship of these two disciplines promises to continue to be an exciting one.

17563 **Collisions of asteroids on neutron stars as a cause of cosmic gamma ray bursts.** Newman, M.J.; Cox, A.N. (Theoretical Division, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico). *Astrophysical Journal ;* **241**: No. 4, 319-325(15 Nov 1980).

The direct collision of asteroid-size bodies with neutron star has been studied by one-dimensional hydrodynamic calculations with radiation diffusion. Gravitational energy is efficiently converted to thermal energy; very high temperatures at the contact point are produced on short time scales. Gamma-ray bursts of observed durations may result from the superposition of many short events from a tidally disrupted parent body. Spectral variation may occur as the temperature evolves and the form of the emitting region varies; the composite time-averaged spectrum need not resemble a blackbody. Long-term periodicity as observed for the 1979 March 5 event (~8 s) can result from the continuing deposition of remnant or preexisting material on the magnetic poles of an oblique rotator subsequent to the primary event in which the bulk of the material is deposited onto the polar caps of the neutron star. The probability of occurrence of such collisions is discussed.

17564 **AM Herculis: simultaneous x-ray, optical, and near-ir coverage.** Szkody, P.; Cordova, F.A.; Tuohy, I.R.; Stockman, H.S.; Angel, J.R.P.; Wisniewski, W. (California Inst. of Tech., Pasadena). *Astrophysical Journal ;* **241**: No. 3, 1070-1076(1 Nov 1980).

A 6 hour x-ray pointing at AM Her using the HEAO 1 satellite is correlated with simultaneous broad-band V and I photometry and visual circular polarimetry. The absence of correlations on either a flickering or an orbital time scale implies distinct regions for the visual and x-ray emission. Significant changes in the light curves are observed from one binary cycle to the next.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 17346

17565 **(LA-UR—81-870) Ionospheric modification by high-power radio waves.** Duncan, L.M. (Los Alamos Scientific Lab., NM (USA)). Apr 1981. Contract W-7405-ENG-36. 11p. (CONF-810421—2). NTIS, PC A02/MF A01.

From Ionospheric effects symposium; Alexandria, VA, USA (14 Apr 1981).

Powerful, high-frequency radio waves have been used to temporarily modify the ionosphere. Thermal and parametric interactions have led to a diverse range of observed phenomena, including generation of density striations and artificial spread-F, enhancements of electron plasma waves, production of extrathermal electron fluxes and enhanced airglow, modification of the D-region temperature and densities, wideband signal attenuation, and self-focusing and scattering of the electromagnetic waves. The physics of ionospheric modification by high-power radio waves is reviewed in the context of our current theoretical understanding; disturbance generation mechanisms are qualitatively described. In addition, results of recent experiments are summarized in which ionospheric irregularities are generated and their evolution and decay processes investigated in detail. The effects and potential controlled applications of these HF ionospheric modifications for various RF systems studies are discussed. The C^3I scientific community provides an important motivation for these ionospheric modification studies; their increased interaction and active participation in experimental design and interpretation are encouraged.

17566 **First measurements of total chlorine and bromine in the lower stratosphere.** Berg, W.W.; Crutzen, P.J.; Grahek, F.E.; Gitlin, S.N.; Sedlacek, W.A. (National Center for Atmospheric Research, Boulder, CO). *Geophysical Research Letters ;* 7: No. 11, 937-940(Nov 1980).

A total halogen collection system employing ultra-pure activated charcoal traps has been developed for use in the stratosphere aboard aircraft and balloon sampling platforms. Neutron activation techniques for low-level chlorine, bromine, and iodine analysis within the activated charcoal sampling matrix were developed. Initial results from six aircraft flights and one balloon mission in the lower stratosphere are presented for latitudes ranging from 16°N to 67°N. Little variability was observed in twelve total, gaseous and particulate chlorine (Cl/sub tot/) determinations as a function of latitude at 20 km with values ranging between 2.7 +- 9 ppbV and 3.2 +- .7 ppbV. Five total bromine (Br/sub tot/) values showed substantial variability ranging from 7 +- 4 pptV to 40 +- 11 pptV. No iodine was observed in any samples but a calculated I/sub tot/ upper limit of < 3 pptV was determined.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 17209

17567 **(BNL—51304) Proceedings of the second international symposium on the production and neutralization of negative hydrogen ions and beams.** Sluyters, T.J.M. (ed.). (Brookhaven National Lab., Upton, NY (USA)). Dec 1980. Contract AC02-76CH00016. 194p. (CONF-801068—). NTIS, PC A09/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Abstracts of individual items from the symposium were prepared separately for the data base. (GHT)

17568 (BNL—51304, pp 10-14) **Production and destruction of H^- and D^- ions in hydrogen or deuterium plasmas.** Bardsley, J.N. (Univ. of Pittsburgh, PA). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

This paper reviews the status of calculations of the cross sections for processes which may lead to the production or destruction of H^- (or D^-) in hydrogen plasmas. Particular attention is given to the collisions involving vibrationally excited H_2 molecules.

17569 (BNL—51304, pp 23-32) **Positive and negative ionization by scattering from surfaces.** Los, J.; Overbosch, E.A.; van Wunnik, J. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam, Netherlands). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Results are reported on the determination of the shift ΔE and the bandwidth Γ of both the valence and the affinity level of Na interacting with a sodiated W(110) surface. The results on the valence band are obtained with a sodium coverage of about $1 \cdot 10^{14}$ atoms $cm^{-2}s^{-1}$. At a distance of 10 a_0 from the surface $\Delta E \simeq 0.7$ eV and $\Gamma \simeq 0.6$ eV. The formation of Na^- is obtained with a coverage of $5 \cdot 10^{14}$ atoms $cm^{-2}s^{-1}$. In this case $\Delta E \simeq -0.6$ eV and $\Gamma \simeq 0.2$ eV. H^- and D^- formation is studied by scattering H^+ respectively D^+ from a cesiated W(110) surface at a coverage of $5 \cdot 10^{14}$ atoms $cm^{-2}s^{-1}$. The width and broadening are in agreement with the theoretical estimates. Maximum efficiency for the formation of negative hydrogen is about 40%. This is obtained at a normal velocity of $2 \cdot 10^6$ cm s^{-1} which corresponds with an energy of 2.5 eV for H and of 5 eV for D.

17570 (BNL—51304, pp 33-41) **Production of negative ions under non-equilibrium conditions.** Bailey, W.F.; Garscadden, A. (Wright-Patterson Air Force Base, OH). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The results of experimental and theoretical studies have shown that the dissociative attachment cross-sections for electron impact of molecular hydrogen are very strong functions of the initial vibrational state of the molecule. The existence of this comprehensive set of cross-sections, which establish the vibrational level and rotational level dependencies of dissociative attachment from the ground electronic state, permits the evaluation of the effect of non-equilibrium level populations on the production rate of H^- in discharges. In this work a self-consistent analysis of the effects of vibrational excitation on the electron energy distribution and on the dissociation attachment rates was performed for typical conditions in hydrogen discharges. The electron kinetics and excitation rates, obtained by numerically solving the electron Boltzmann transport equation, were coupled to the first order time derivative population equations for the vibrational levels. The dissociative attachment rate was calculated as a function of E/N, (where E is the applied electric field and N is the total gas density), gas temperature and fractional ionization. Under conditions of high vibrational excitation there is a significant increase in the energy deposited into dissociative attachment as compared to that for a gas at a low vibrational temperature. Calculations have been made which show that the cooling of the gas to 200°K,coupled with efficient vibrational pumping, results in the total rate of negative ion formation exceeding that from the ground state by over three orders of magnitude. The possibilities of achieving these conditions are considered.

17571 (BNL—51304, pp 51-57) **Theoretical investigations of the collision dynamics in H^- formation and destruction.** Olson, R.E. (SRI International, Menlo Park, CA). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A short review is presented on some of the recent theoretical investigations on heavy particle collision problems related to conversion of beams of H^+ to H^- via sequential capture of two electrons from metal vapor targets. Primarily, the investigations are on alkali metal vapor targets; however, recent calculations indicate there may be several advantages to using heavy alkaline earth vapor targets for ion sources based on low energy collisions, $E \lesssim 500$ eV/amu. Mention is also given to the effects of using laser excited alkali atom targets and to collisional processes which dominate the angular scattering of the hydrogen beams.

17572 (BNL—51304, pp 58-64) **Angular scattering in electron capture and loss D^- beam formation processes.** Coggiola, M.J.; Hodges, R.V.; Huestis, D.L.; Peterson, J.R. (SRI International, Menlo Park, CA). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The development of high energy (> 150 keV) neutral beams for heating and fueling magnetic fusion devices depends on the ability to produce well-collimated negative ion beams. The double capture charge-exchange technique is a known, scalable method. In order to maximize the overall efficiency of the process and to achieve the desired beam characteristics, it is necessary to examine the optical qualities of the beams as well as the total efficiency of beam production. A combined modeling and experimental study of the angular scattering effects in negative ion formation and loss processes has therefore been undertaken.

17573 (BNL—51304, pp 81-89) **Limiting secondary plasma effects in cesium cells or jets used in the double charge exchange method for D^- beam production.** Dolique, J.M. (Universite de Grenoble, France). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

One of the two principal presently developed methods of producing the intense D^- beams required for magnetic fusion plasma additional heating, is the double charge exchange. On a cell or jet of an electropositive gas such as cesium, a D^+ beam is partially transformed into a D^- beam by D^+ Cs Cs/D^0 Cs^+ Cs/D^- Cs^+ Cs^+. At the same time a Cs^+, e^- secondary plasma is formed which in its turn gives rise to inelastic collisions with the beam: some D^- ions are destroyed. Production and dynamics of that reactive plasma are studied theoretically for the cell case. An axial magnetic field is present, as in the major existing double charge exchange D^- source. The D^- efficiency is discussed. Finally preliminary results for the jet case are presented which emphasize the interest of this method.

17574 (BNL—51304, pp 90-94) **Measurement of H^- and D^- density in plasma by photodetachment.** Hamilton, G.W.; Bacal, M.; Bruneteau, A.M.; Doucet, H.J.; Nachman, M. (Ecole Polytechnique, 91, Palaiseau, France). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A technique for measuring the density of H^- and D^- ions in a plasma by photodetachment is described. Photodetachment is detected by the increase in electron density with no change in positive ion density after a light pulse from a ruby laser. The authenticity of photodetachment signals can be assured by their comparison with known cross sections for photodetachment of H^-, and by mass analysis of extracted ions. The choice of photon energy, laser pulse energy and laser beam diameter will be discussed.

17575 (BNL—51304, pp 95-105) **H^- and D^- production in plasma.** Bacal, M.; Bruneteau, A.M.; Doucet, H.J.; Graham, W.G.; Hamilton, G.W. (Ecole Polytechnique, 91, Palaiseau, France). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The density of negative ions in a low pressure hydrogen plasma has been investigated as a function of neutral gas pressure, plasma density and electron temperature, using the photodetachment technique. A new multifilament, metal wall device was used to extend the plasma density range up to 10^{11} cm^{-3}. The transition to the regime where ion-ion recombination dominates negative ion loss has been observed at the n/sub e/ $\sim$ 2 x 10^{10} cm^{-3}. Measurements by coherent anti-Stokes Raman scattering (CARS) and calculations of the vibrational population distribution will be discussed. The comparison of the experimental data with theoretical results derived from computed reaction rates, seems to indicate that hydrogen negative ion production occurs, mainly, through the process of electron attachment on vibrationally excited hydrogen molecules.

17576 (BNL—51304, pp 106-110) **H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors.** Mayo, M. (Wesleyan Univ., Middletown, CT); Stone, J.; Morgan, T.J.; Alvarez, I.; Cisneros, C. Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Data are presented on H^- negative ion formation in H^+ and H^0 collisions with alkaline-earth metal vapor targets. Data on H^- formation in multiple-collision thick targets is reported, as well as H^- formation via single and double electron capture in a single collision. Low energy angular scattering data is also presented for the double electron capture process $H^+ \rightarrow H^-$ in Mg.

17577 (BNL—51304, pp 111-118) **Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions.** Seidl, M.; Pargellis, A.N.; Greer, J. (Stevens Inst. of Tech., Hoboken, NJ). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Measurements of secondary emission yields of negative hydrogen ions from some metal hydride targets bombarded with positive cesium ions are presented. The following targets have been investigated: LiH (max. yield 0.07), CsH (max. yield 0.4), VH (max. yield 0.4), CsOH (max. yield (0.18). The maximum yields occur for bombardment energies from 6 to 10 keV. The yields of electrons, impurity ions and neutrals are also presented. Formation of H^- ions by backscattering of thermal H atoms from a cesium surface has been observed with an efficiency of 10^{-4} H^- ions per incident H atom. Emission of exoelectrons accompanying chemisorption of H atoms on cesium occurs with an efficiency of 10^{-2} electrons per incident hydrogen atom.

17578 (BNL—51304, pp 119-125) **Low work function surface for improving the yield of negative hydrogen ions.** Huffman, F.N.; Oettinger, P.E. (Thermo Electron Research and Development Center, Waltham, MA). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Measurements at Lawrence Berkeley Laboratory show an excellent correlation between increasing yield of negative hydrogen ions and decreasing electrode work function. Surfaces with work functions less than 1.6 eV (typical minimum for cesium on clean metals) are almost always associated with compositions involving cesium and oxygen. Usually, low work function surfaces can be attained only by critical adjustment of separate cesium and oxygen sources. However, in work related to thermionic energy conversion at Thermo Electron, Briere and Sommer have reported on a reproducible surface with a work function of 1.1 eV that can be formed without separate oxygen and cesium sources. The properties at this surface have been found to be insensitive to substrate composition, film thickness, and hydrogen exposure. Such a surface should be useful in enhancing the yield of negative ions from direct extraction sources. A thermal spike model is used to interpret the experimental data.

17579 (BNL—51304, pp 126-133) **Properties of alkali metals adsorbed onto metal surfaces.** Graham, W.G. (New Univ. of Ulster, Northern Ireland). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Experimental measurements of the work function of metal and alkali metal covered surfaces are reviewed. A method for producing surfaces of different known work functions for backscattering experiments is described.

17580 (BNL—51304, pp 137-144) **Some effects of surface-plasma mechanism for production of negative ions.** Dudnikov, V.G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The effects attributable to production of negative ions via the surface-plasma mechanism are analyzed and their use in the production of negative ion beams and accelerated atoms is discussed.

17581 (BNL—51304, pp 189-193) **Operation of the Fermilab H^- magnetron source.** Schmidt, C.W. (Fermi National Accelerator Lab., Batavia, IL). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A magnetron type ion source is being used at Fermilab to produce negative hydrogen-ions for acceleration in the Linac and charge-exchange injection in the Booster. Operation of the Linac, Booster and ion source is discussed.

17582 (BNL—51304, pp 213-216) **Proposed electrode design for direct extraction of negative ion beams.** Holmes, A.J.T.; Green, T.S.; Inman, M. (Culham Lab., Abingdon, England). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The major difficulty in the extraction and acceleration of a negative ion beam is the suppression of the unwanted electron beam. This problem is simplified by the double charge exchange technique which converts an initial H^+ beam into an H^- beam in a caesium cell, although the conversion efficiency is low. An alternative technique is to accelerate both the electrons and negative ions together to a low energy and then deflect the electrons to a dump by a transverse magnetic field while the negative ions are accelerated to their final energy. Usually this magnetic field forms an integral part of the ion source as in the magnetron negative ion source, or more recently in the bucket type. In these types of sources the electrons are reflected by the magnetic field back towards the discharge although they may not necessarily re-enter the extraction aperture. Here, a modification of this scheme is presented where the accelerating structure can be a multislit array and is combined with a transverse magnetic field localized in each slit. This type of structure has the advantage that it can in principle be scaled up to any size, as in the case of positive ions.

17583 (BNL—51304, pp 225-232) **Characteristics of a modified duoPIGatron negative ion source.** Tsai, C.C.; Feezell, R.R.; Haselton, H.H.; Ryan, P.M.; Schechter, D.E.; Stirling, W.L.; Whealton, J.H. (Oak Ridge National Lab., TN). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A Cs converter in a duoPIGatron positive ion source is able to produce negative ions efficiently. The negative ions are accelerated by an electrostatic accelerator as that in the conventional positive ion source. The low energy ion beams of 1 keV/0.2A are being analyzed. The heavy impurity content in H^- beams is about 10%, that in D^- beams is more. The built-in electron suppressor can reduce electron fraction below 10%. In addition to these preliminary data, other significant results are reported and discussed.

17584 (BNL—51304, pp 233-239) **Conceptual D^- source exploiting negative surface ionization of deuterons.** Hopman, H.J.; van Bommel, P.J.; Massmann, P.; Granneman, E.H.A. (FOM-Inst. for Atomic and Molecular Physics, Amsterdam, Netherlands). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Under conditions of grazing incidence (θ = 75 to 85°) deuterons are specularly reflected from cesiated monochrystals of W, even at energies of a few keV. A fraction of 10 to 45% is charged negatively during the process. These features suggest an improved concept of a D^--source in which the extraction of a high quality beam is separated from the formation of D^--ions. We shall discuss an experiment designed to test the above ideas at high current densities (250 mA cm^{-2}). The aim is the development of a source delivering a 50 mA cm^{-2} negative hydrogen beam at 20 kV having a divergence of 6°.

17585 (BNL—51304, pp 247-254) **Prospects for negative ion systems based on charge exchange.** Hooper, E.B. Jr.; Poulsen, P. (Lawrence Livermore National Lab., CA). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Experiments on the production of H^- and D^- by charge exchange in alkali metals are reviewed. It is shown that the results can be calculated accurately from knowledge of the positive-ion characteristics and atomic cross sections. D^- sources for injection into a high voltage accelerator are considered as a function of positive-ion energy. Minimum dimensions are obtained at energies of 1.5-2 keV with conversion in rubidium.

17586 (BNL—51304, pp 255-262) **Production of D^- ions by double charge exchange of D^+ on cesium.** Delaunay, M.; Foucher, J.L.; Geller, R.; Jacquot, C.; Ludwig, P.; Mazhari, F.; Ricard, E.; Rocco, J.C.; Sermet, P.; Zadworny, F. (Association EURATOM-CEA, Grenoble, France). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A D^- beam immersed in a high uniform magnetic field has been produced by a double charge exchange of D^+ in a supersonic cesium target. The average D^- current density is 10 to 12 mA/cm^2 with a pulse duration of 1 s. With a beam of 750 mA of D^+, a total D^- current of 160 mA at 1 keV is obtained. The physics of the production and destruction of D^- will be discussed later.

17587 (BNL—51304, pp 263-269) **Negative ion production by charge exchange of hydrogen clusters with a cesium vapor target-status report.** Hagena, O.F.; Henkes, P.R.W.; Klingelhoefer, R.; Krevet, B.; Moser, H.L. (Institut fuer Kernverfahrenstechnik, Karlsruhe, Germany). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

It has been shown that negative hydrogen ion production through charge exchange of cesium vapor with the neutral molecular fragments of accelerated hydrogen clusters is similar to that from molecular or atomic positive ions (double charge exchange). Based on this result the Karlsruhe negative ion project will use the cluster method to obtain 1 A negative current from a 5 cm diameter cluster beam. The paper presents data for the primary cluster beam and discusses the design and construction of the cesium jet target. The description of the apparatus includes data for two types of LHe cryopumps to be used in the charge exchange chamber.

17588 (BNL—51304, pp 270-281) **Cesium supersonic jet for D^- production by double electron capture.** Bacal, M. (Ecole Polytechnique, 91, Palaiseau, France); Buzzi, J.M.; Doucet, H.J.; Labaune, G.; Lamain, H.; Stephan, J.P.; Delaunay, M.; Jacquot, C.; Ludwig, P.; Verney, S. Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

A supersonic jet of cesium vapor has been built for D^- production by double electron capture. The produced target thickness n l is 3.5 10^{15} atomes.cm^{-2} for an oven temperature of 600°C. The average cesium jet geometrical thickness is only 2.2 cm when a condensing skimmer is used. The jet flux is determined from calorimetric measurements and is found to be in good agreement with simple slit type jet calculations. The jet profile is measured with a thin thermocouple moving across the cesium jet.

17589 (BNL—51304, pp 285-290) **Stripping of 30-2000 keV H^- ions.** Anderson, L.W.; Anderson, C.J.; Girnius, R.J.; Howald, A.M. (Univ. of Wisconsin, Madison). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Measurements on the stripping of 30 to 200 keV H^- ions to produce fast H^0 atoms are discussed. The maximum neutral fraction is repoted for H^- ions incident on a large variety of gas and vapor targets. Efficient neutralization is obtained in Li, Na, Cs, and H_2. We also report measurements of the total charge changing cross sections δ/sub -o/, δ/sub -+/, δ/sub g+/, and δ/sub g-/ for fast H^- ions and fast ground level H^0 atoms incident on a variety of gas and vapor targets.

17590 (BNL—51304, pp 315-320) **US negative ion neutral beam development program.** Staten, H.S.; Haas, G.M.; Coffman, F.E. (Dept. of Energy, Washington, DC). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

The needs for neutral beams are reviewed. A simple analysis indicating when 10 ampere negative ion systems are competitive with positive ion systems is presented. The US Negative Ion Development Program Plan is reviewed. Three US laboratories are each developing source concepts through the 1 ampere level. It is expected that sufficient work will be done by the summer of 1981, such that a choice can be made of the source concept most likely to be successful. Effort will then be concentrated on a 10 ampere version.

17591 (BNL—51304, pp 304-311) **Laser neutralization of negative ion beams for fusion.** McGeoch, M.W. (Avco Everett Research Lab., Inc. MA). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

An expression is derived for the efficiency of a D^0 beam neutralized by laser photodetachment of D^- ions. The effects of ion beam space charge are included. The D^0 beam efficiency is shown to depend almost equally upon the ion beam emittance, the laser efficiency, the reflectivity of the laser mirrors and the neutral beam power. Beam line efficiency can approach 100% in conditions of interest to current reactor designs.

17592 (BNL—51304, pp 321-329) **Merits of D^--based neutral beam injectors for tokamaks.** Stewart, L.D.; Boozer, A.H.; Eubank, H.P.; Goldston, R.J.; Jassby, D.L.; Mikkelsen, D.R.; Post, D.E.; Prichard, B.; Schmidt, J.A.; Singer, C.E. (Princeton Univ., NJ). Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Model-based efficiencies and costs of D^+ and D^- neutral beam systems are presented and compared. The results of modeling of the heating and the current driving by D^- generated neutral beams are presented. PLT experimental data on heating as a function of beam penetration are presented and discussed. Efficiencies, costs, heating, and current driving are combined to derive the merits of D^--based neutral beam injector for tokamaks.

17593 (BNL—51304, pp 350-354) **D^- ion accelerator immersed in a magnetic field.** Foucher, J.L. (Association EURATOM-CEA, Grenoble, France); Geller, R.; Jacquot, C.; Rocco, J.C.; Sermet, P.; Bergstroem, J.B.; Gustavson, H.G.; Hellbloem, R.P. Dec 1980.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

An analysis of the physical condition of a D^- accelerator immersed in a high magnetic field is being considered. At the entrance the D^- current density is 10 to 15 mA/cm^2 and the final energy is 300 keV. A compressed beam could be achieved and consequently a final current density of 20 to 50 mA/ cm^2 is obtained. An electrostatic reflector for electrons with a high transparency is defined. A maximum of 10^{11} e/cm^3 electron density can be reflected. The steady state electric field in the accelerator is of the order of 22 kV/cm.

17594 (DOE/ER/04971—3) **Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981.** Bederson, B. (New York Univ., NY (USA). Dept. of Physics). Feb 1981. Contract AS02-78ER04971. 29p. NTIS, PC A03/MF A01.

The basic goals of this program concern the experimental determination of properties of atoms and molecules and molecular clusters that are important in a wide range of energy-related processes, in particular, measurements of polarizabilities of highly polar molecules and their polymers, and of a number of important atomic elements distributed through the periodic table, as well as of the scattering of low-energy electrons by these same systems. The most significant scientific accomplishment of the program during the past year has been the completion of measurements of the dc electric dipole polarizabilities of a number of alkali halide dimers [$(KCl)_2$, $(RbCl)_2$, $(CsCl)_2$, $(KF)_2$, and $(CsF)_2$]. An experiment was completed to measure the total cross sections for the scattering of low-energy electrons by atomic lithium, a very significant experimental test of a relatively simple, many-body system, which is amenable to elaborate computational determination.

17595 (DOE/ER/06036—1) **X-ray emission in heavy-ion collisions. Progress report, April 1, 1980-February 28, 1981.** Watson, R.L. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). Mar 1981. Contract AS05-78ER06036. 35p. NTIS, PC A03/MF A01.

During the past year, work on x-ray emission in heavy-ion collisions has concentrated on the following topics: environmental influences on the Kα x-ray spectra of 65-MeV sulfur ions traveling in solids; multiplet structure of few-electron sulfur ions; multiplet structure of Mg Kα x-ray satellites; polarization of $1s2p \rightarrow 1s^2$ transitions in He-like sulfur ions; and interatomic electron transfer in ionic fluorine compounds following 1s2p vacancy production. Among the most significant accomplishments of the program was a study of the dependence of dynamic screening energy shifts on electron density. It was found that the shifts measured for the $2^1P \rightarrow 1^1S$ and $2^3P \rightarrow 1^3S$ x-ray transitions of He- and H-like sulfur ions (respectively) were in remarkably good agreement with theoretical expectations. Another interesting discovery evolved from measurements of fluorine Kα x-ray spectra for the alkali metal and alkaline earth fluorides using 5.5-MeV He^+ ions. The systematics of these spectra provide the first evidence for direct electron transfer between inner levels of neighboring atoms in a solid. 10 figures, 3 tables. (RWR)

17596 (DOE/ER/10454—1) **Physical adsorption: rare gas atoms on solid surfaces. Progress report, June 1, 1980-May 31, 1981.** Cole, M.W. (Pennsylvania State Univ., University Park (USA)). Feb 1981. Contract AC02-79ER10454. 15p. NTIS, PC A02/MF A01.

This project has entailed investigation of three areas during the current term: physical adsorption, photostimulated field emission (PSE), and phonon reflection at interfaces. The principal effort has been directed toward understanding interactions associated with physical adsorption and the associated properties of a film. The specific topics pursued include the detailed form of the long range interaction, the configuration space wave function, and the interaction between adatoms. Experimental confirmation of the last two come from neutron scattering and thermodynamic measurements, respectively. The research in PSE has yielded results which improve upon previous calculations. There is, however, a remaining disagreement with experiment; suggestions for the origin are discussed. The phonon reflection work is directed toward understanding the role of surface roughness, an important factor in increasing the energy transmission across interfaces. A formalism has been developed which will be evaluated in the future.

17597 (DOE/ER/10496—2) **Sizes and shapes of short-lived nuclei via laser spectroscopy. Progress report, May 1, 1980-January 31, 1981.** Lewis, D.A. (Iowa State Univ. of Science and Technology, Ames (USA)). Feb 1981. Contract AC02-79ER10496. 39p. NTIS, PC A03/MF A01.

The first stage of the program to study the sizes and shapes of short-lived nuclei through their atomic hyperfine structure is to develop a movable laser spectroscopy system. This system is now almost complete and is described in this report along with plans for measurements at Argonne National Laboratory and Brookhaven National Laboratory.

17598 (DOE/ER/10514—12) **Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981.** Lin, C.D. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Mar 1981. Contract AC02-79ER10514. 55p. NTIS, PC A04/MF A01.

Studies of electron correlations of doubly-excited electrons in hyperspherical coordinates, and differential and total cross sections for charge transfer and ionization in fast ion-atom collisions are reported. (GHT)

17599 (DOE/ER/10746—T1) Experimental investigation of the ionizations, electronic strucutre, and bonding of small molecules attached to transition metals. Progress report, 1 September 1980-1 April 1981. Lichtenberger, D.L. (Arizona Univ., Tucson (USA). Dept. of Chemistry). 1981. Contract AC02-80ER10746. 18p. NTIS, PC A02/MF A01.

Progress is reported on measurements of vibrational fine structure in the valence ionizations of group IVB hexacarbonyls; the Jahn-Teller effect in the photoelectron spectrum of $Fe(CO)_5$; the effects of methyl group substitution on metal-coordinated cyclopentadienyl rings; valence ionizations of olefins coordinated to metals; and the valence electronic structure of bridging methylenes. (GHT)

17600 (DOE/EV/04361—T2) [Fluorescent scattering by molecules embedded in small particles]. Comprehensive report, 1977-1980. McNulty, P.J.; Chew, H.W. (Clarkson Coll. of Tech., Potsdam, NY (USA)). 1980. Contract AS02-77EV04361. 11p. NTIS, PC A02/MF A01.

Research to develop a model for calculating inelastic (Raman and fluorescent) scattering by active molecules which are embedded in a dielectric particle with microscopic dimensions is described. (GHT)

17601 (DOE/EV/04703—T1) [Interaction of slow electrons with high-pressure gases (quasi-liquids): synthesis of our knowledge on slow electron-molecule interactions. Progress report for year ending May 31, 1981. Christophorou, L.G.; McCorkle, D.L. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1981. Contract AS05-76EV04703. 16p. NTIS, PC A02/MF A01.

Research on electron interactions with molecules at high pressure is reported. This includes electron collisions with chlorofluoroethanes; temperature dependence of electron attachment to halocarbons; electron energy distribution functions in argon; the role of electron attachment in the breakdown strength of gaseous dielectrics; a new high temperature swarm experiment; electron scattering from molecules of environmental interest; negative ions of polyatomic molecules; electron motion in high pressure polar gases (NH_3); fast gases for radiation detectors; and electron affinities of atoms and molecules. (GHT)

17602 Effects of hyperfine structure on coherent excitation. Shore, B.W.; Johnson, M.A. (Lawrence Livermore National Lab., CA). Contract W-7405-ENG-48. *Physical Review, The, A. General Physics ;* **23**: No. 4, 1608-1610(Apr 1981).

We point out how the presence of hyperfine structure can improve the coherent excitation and ionization of J → J-1 and J → J transitions. In the limit of Rabi frequency dominating hyperfine splitting one recovers previously noted rules.

17603 Ionization of uranium atoms by electron impact. Halle, J.C.; Lo, H.H.; Fite, W.L. (Univ. of Pittsburgh, PA). Contract EN-77-5-02-4295.A000. *Physical Review, The, A. General Physics ;* **23**: No. 4, 1708-1716(Apr 1981).

The cross sections for single and multiple ionization of uranium by electron impact for energies 7.5 to 500 eV have been measured using a modulated crossed-beam experiment. The absolute total ionization cross section was found by comparing the cross section for ionization to the cross section for associative ionization in the reaction $U + O_2 \rightarrow UO_2/sup\ ts+/+e$. The total ion number cross section has a maximum value of (5.8 +- 0.9) x 10^{-16} cm^2 occurring at an energy of about 50 eV. The single ionization cross section has a maximum of (4.80 +- 1.24) x 10^{-16} cm^2 at an energy of 27 +- 5 eV. The cross sections for higher-order ionization have values at 500 eV that are 49%, 33%, and 17% that of single ionization for n = 2, 3, and 4, respectively. These ratios are significantly higher than those for other elements for which data are available.

17604 Scattering by a dipolar system: divergence of cross sections at the critical moment for a point dipole rotor. Garrett, W.R. (Oak Ridge National Lab., TN). *Physical Review, The, A. General Physics ;* **23**: No. 4, 1737-1744(Apr 1981).

It is shown that the quantum-mechanical problem of charged-particle scattering by a point-dipole rotor has pathological behavior at and above the critical dipole moment wherein all partial-wave components of the solution become undefined. The total elastic and momentum-transfer cross sections diverge at the critical moment, and, at energies above thresholds, scattering in inelastic channels behaves similarly. Clarifications are made of some existing contradictions in the literature on the quantum mechanics of continuum states for dipolar systems.

17605 Energy dependence of alignment in foil collision-excited n = 3 states of He I. Gay, T.J.; Berry, H.G.; DeSerio, R.; Garnir, H.P.; Schectman, R.M.; Schaffel, N.; Hight, R.D.; Burns, D.J. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Physical Review, The, A. General Physics ;* **23**: No. 4, 1745-1760(Apr 1981).

We have measured the beam-foil collision-induced alignment of the 3p ^1P, 3p ^3P, 3d ^1D, and 3d ^3D states of He I for He^+ beam energies between 30 and 1300 keV. The alignment of all four states is found to vary with beam-current density as well as energy. The number of secondary electrons emitted per incident ion, γ, has also been measured as a function of foil temperature and beam energy between 400 and 1400 keV. The rate of change of both alignment and γ with foil temperature exhibits a general correlation. The energy dependence of alignment may be understood in terms of simple impact-excitation collisions. We also discuss our results in terms of the Kupfer-Winter surface electric-field model. The interaction between atoms emerging from the foil and slow secondary electrons is considered.

17606 Molecular effects in beam-foil collision-induced alignment of He I. Gay, T.J.; Berry, H.G.; DeSerio, R. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Physical Review, The, A. General Physics ;* **23**: No. 4, 1761-1774(Apr 1981).

We have measured the alignment of beam-foil collision-excited states of He I produced by bombarding carbon foils of various (1.3 to 110 $\mu g/cm^2$) areal densities with beams of He^+ and HeH^+. In addition, we have measured the total light yield of several transitions in He I, He II, and H as a function of foil thickness using beams of HeH^+ ions. Experiments were done with He-foil exit energies of 125, 500, 550, and 650 keV. He I alignment decreases in all cases for the thinnest foils when molecular projectiles are used. Total light intensities generally increase with thin foils (small proton-He emergent internuclear separation), but a few decrease or are independent of foil thickness. We are able to explain several features of the alignment and intensity data in terms of the formation of quasimolecular HeH^+ states at or near the foil surface. Alignment reduction results from incoherent Stark mixing of the He I excited states in the field of the close proton. A calculation of the rms emergent H-He internuclear separation as a function of foil thickness and beam energy is presented.

17607 Probing the helium-graphite interaction. Cole, M.W.; Frankl, D.R.; Goodstein, D.L. (Physics Department, The Pennsylvania State University, University Park, Pennsylvania 16802). DE-AC02-79ER10454. *Reviews of Modern Physics ;* **53**: No. 2, 199-210(Apr 1981).

Two separate lines of investigation have recently converged to produce a highly detailed picture of the behavior of helium atoms physisorbed on graphite basal plane surfaces. Atomic beam scattering experiments on single crystals have yielded accurate values for the binding energies of several states for both ^4He and ^3He, as well as matrix elements of the largest Fourier component of the periodic part of the interaction potential. From these data, a complete three-dimensional description of the potential has been constructed, and the energy band structure of a helium atom moving in this potential calculated. At the same time, accurate thermodynamic measurements were made on submonolayer helium films adsorbed on Grafoil. The binding energy and low-coverage specific heat deduced from these measurements are in excellent agreement with those calculated from the band structures.

17608 Temperature-controlled cell for laser-induced fluorescence and absorption studies. Shelton, R.N. Jr.; Rice, W.W.; Wampler, F.B.; Tiee, J.J. (University of California, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). W-7405-ENG-36. *Review of Scientific Instruments, The ;* **52**: No. 4, 576-578(Apr 1981).

A temperature-controlled cell has been constructed for laser-induced fluorescence studies of UF_6 and other corrosive gases. The temperature stability achieved in our UF_6 fluorescence investigation was +- 0.1 °C from -30° to 0 °C and +- 0.05 °C from 0° to 80 °C. The cell has also been used in UF_6 absorption measurements at temperatures as high as 100 °C with comparable stability.

17609 **Matrix—molecule interactions, dynamics, and exchange phenomena in low temperature matrices: SF_6 in argon and krypton.** Swanson, B.I.; Jones, L.H. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). W-7405-ENG.36. *Journal of Chemical Physics, The ;* **74**: No. 6, 3205-3215(15 Mar 1981).

High resolution infrared studies of argon/SF_6 and krypton/SF_6 matrices at 10 000/1 show an unexpected amount of structure; 10—12 peaks are observed in argon and six or more peaks in krypton matrices for the ν_3 mode. Studies in which the deposition temperatures are varied, in conjunction with the structure observed for combination modes and temperature reversible spectral changes, allowed differentiation between multiple trapping sites and site symmetry splittings. We conclude that there are at least six different sites for monomeric SF_6 in argon and at least three sites in krypton. Two sites in argon and two in krypton exhibit site symmetry splittings. Temperature dependence studies have shown striking spectral changes wherin for three of these sites (one in argon and two in krypton) the peaks, due to site symmetry splitting, coalesce as the temperature is raised. The temperature dependence can be explained in terms of exchange dephasing involving two high energy fundamentals and a local phonon mode. The dynamics associated with motional collapse of the high enery fundamentals corresponds to rapid site-to-site exchange on a less than nanosecond time scale resulting in higher effective site symmetry as observed by infrared. Unusual ^{32}S—^{34}S isotope effects have also been observed for the spectra of these low temperature matrices.

17610 **High resolution infrared studies of dynamics in low temperature matrics: Vibrational dephasing for SeF_6 in noble gas solids.** Jones, L.H.; Swanson, B.I. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG-36. *Journal of Chemical Physics, The ;* **74**: No. 6, 3216-3224(15 Mar 1981).

High resolution infrared absorption spectra for the ν_3 mode of SeF_6 in low temperature noble gas matrices have been observed. A remarkable amount of structure is observed leading to the conclusion that multiple trapping sites as well as site symmetry splittings, similar to those observed previously for SF_6, are common. Temperature dependent studies give a rich display of dynamics arising from host—guest interactions. These give evidence for dynamic exchange among equivalent low symmetry sites within a given trapping cage. This exchange is evidence for a dephasing of the components of ν_3 by a local site phonon mode in resonance with part of the phonon bath. Unexpected matrix shifts and intensity changes with temperature have been observed. Accurate isotope shifts, especially in a neon matrix, are shown to be useful for calculation of potential constants. A discussion of host—guest interactions, dephasing, and dynamic site exchange in these matrices is given.

17611 **Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer.** Loeb, D.W.; Chen, M.; Firestone, R.F. (Department of Chemistry, The Ohio State University, Columbus, Ohio 43210). *Journal of Chemical Physics, The ;* **74**: No. 6, 3270-3277(15 Mar 1981).

Rate constants for bimolecular quenching of Ar (1s) resonance-state and metastable atoms by N_2, H_2, and O_2 have been measured by fast absoprtion spectrophotometry at argon pressures in the 10^2—10^3 Torr region at 298 K. "Three-body" quenching attributed to collisional relaxation of vibrationally excited dissociative excimer molecules by molecular quenching agents has been observed to occur efficiently for all Ar (1s) atoms in the presence of H_2 and O_2, but only for the resonance-state Ar (1s) species in the presence of N_2. A discussion and analysis of the temporal behavior and the yield of Ar_2 ($^3\Sigma^+$/sub u/) molecules in the context of the mechanism for Ar (1s) atom decay and excimer formation indicates that the predominant precursors of the first triplet argon excimer in Ar/N_2 mixtures are probably Ar ($^3P_2$) atoms and Ar_2 van der Waals molecules, the latter through the agency of N_2 (C ^{3}Pi/sub u/) at higher N_2 concentrations.

17612 **Molecular beam photoionization study of CO, N_2, and NO dimers and clusters.** Linn, S.H.; Ono, Y.; Ng, C.Y. (Ames Laboratory, U. S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics, The ;* **74**: No. 6, 3342-3347(15 Mar 1981).

Photoionization efficiency (PIE) data for $(CO)^+_2$, $(N_2)^+_2$, and $(NO)^+_2$ have been obtained near the thresholds using the molecular beam method. The ionization energies (IE) for $(CO)_2$, $(N_2)_2$, and $(NO)_2$ were measured to be 13.05 +- 0.04 eV (950 +- 3 A), 14.69 +- 0.05 eV (844 +- 3 A), and 8.736 +- 0.002 eV (1419.2 +- 0.3 A), respectively. Using these values, the known IE's for CO, N_2, and NO, and the estimated binding energies for $(CO)_2$, $(N_2)_2$, and $(NO)_2$, the bond dissocations energies for CO^+xCO, N^+_2xN_2, and NO^+xNO were deduced to be 0.97 +- 0.04, 0.90 +- 0.05, and 0.598 +- 0.006 eV, respectively. From the analysis of the PIE curve for $(NO)^+_2$, the IE's of $(NO)_2$ to NO^+($X^1\Sigma^+$, v=1)xNO and NO^+($X^1\Sigma^+$,v=2)xNO were determined to be 8.997 +- 0.007 eV (1 378 +- 1 A°) and 9.253 +- 0.013 eV (1 340 +- 2 A°), respectively. This measurement supports the conclusion that the bonding of NO^+ in NO^+xNO is stronger than that of NO, but weaker than that of NO^+. The IE's for $(CO)_n$, $(N_2)_n$, and (NO)/sub n/=3—6 were also measured.

17613 **Large multiconfiguration self-consistent-field wave functions for the ozone molecule.** Laidig, W.D.; Schaefer, H.F. III. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics, The ;* **74**: No. 6, 3411-3414(15 Mar 1981).

The electronic structure of the ozone molecule is of particular interest in light of Goddard's characterization of the ground state as a biradical. Rigorously optimized multiconfiguration self-consistent-field (MCSCF) wave functions of varying size have been determined here for ozone via newly developed techniques utilizing the unitary group approach. The largest of these ab initio MCSCF wave functions includes 13 413 configurations, i.e., all singly- and doubly excited configurations relative to the two reference configurations required for the biradical description of ozone. The convergence of the MCSCF procedures is discussed, as well as the structure of the MCSCF wave functions, and the effectiveness of different orbital transformations. There is a significant energy difference (0.034 hartrees) between the MCSCF wave functions involving one and two reference configurations. This gives emphasis to the fact that orbital optimization alone cannot compensate for the exclusion from the wave function of important classes of configurations. A simple test for the determination of the fraction biradical character of systems such as ozone suggests 23% biradical character for O_3 at its equilibrium geometry.

17614 **INDO and MINDO/3 atom-in-molecule polarizabilities.** Metzger, R.M. (Department of Chemistry, The University of Mississippi, University, Mississippi 38677). *Journal of Chemical Physics, The ;* **74**: No. 6, 3444-3457(15 Mar 1981).

The INDO and MINDO/3 finite-perturbation algorithms for computing the molecular static electric dipole polarizability tensor α/sub M/ were applied to obtain a set of atom-in-molecule polarizability tensors α/sub i/ useful for crystal lattice energy calculations. The decomposition of α/sub M/ into the α/sub i/ must yield symmetric tensors, and requires the invention of a scheme to assign bond moments for closed-ring atoms. The resulting α/sub i/ depend on the molecular geometry and seem to describe local bonding effects rather well. They underrate the polarizability perpendicular to covalent bonds (because of a lack of polarization functions in the INDO and MINDO/3 basis set) but the MINDO/3 α/sub i/ values are rather close to the atom polarizability tensors derived from experimental data by Applequist.

17615 **MINDO/3-FP atom-in-molecule polarizabilities of TCNQ, TTF, TMPD, and of their radical ions.** Metzger, R.M. (Department of Chemistry, University of Mississippi, University, Mississippi 38677). *Journal of Chemical Physics, The ;* **74**: No. 6, 3458-3471(15 Mar 1981).

The MINDO/3-FP method was used to obtain molecular polarizabilities α and atom-in-molecule polarizabilities α/sub i/ for the neutral molecules 7,7,8,8-tetracyanoquinodimethane (TCNQ), tetrathiofulvalene (TTF), and N,N,N',N'-tetramethylparaphenylenediamine (TMPD), and their radical ions $TCNQ^-$, TTF^+, and $TMPD^+$. Except for the direction perpendicular to the molecular plane, the α and the α/sub i/ describe fairly well the covalent bonding environment. The radical ions are more polarizable than their parent neutral molecules, but not spectacularly so. The α/sub i/ appear to be covalent bond polarizabilities, and are the largest for the atoms that lie on the longest molecular axis.

17616 **Theoretical characterization of the potential energy curve for hydrogen atom addition to molecular oxygen.** Dunning, T.H. Jr.; Walch, S.P.; Goodgame, M.M. (Theoretical Chemistry Group, Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). W-31-209-ENG-38. *Journal of Chemical Physics, The ;* **74**: No. 6, 3482-3488(15 Mar 1981).

Large scale polarization configuration interaction (POL-CI) calculations are reported on the HO_2 molecule. For the structure of the stable complex the calculations predict (with experimental values in parentheses) R/sub OH/=0.99 A(0.971 A), R/sub OO/ =1.37 A (1.335 A), and θ/sub HOO/=103°(104.1°). The calculated harmonic frequencies (3655, 1416, and 1181 cm^{-1}) are also in good agreement with those derived from experiment. On the other hand, the H—O_2 bond energy obtained in the calculations (42 kcal/mole) is too small by ~10 kcal/mole (an inherent defect in the POL-CI method). Although both the GVB and GVB-CI calculations predict barriers of ~3 kcal/mole to the addition of a hydrogen atom to molecular oxygen, the POL-CI calculations reduce the barrier to less than 0.4 kcal/mole. Taking the computational limitations into account, there may well be no barrier at all to the addition reaction.

17617 **Experiments on selective excitation of multiple-quantum transitions in NMR spectroscopy.** Warren, W.S.; Pines, A. (Lawrence Berkeley Lab., CA). *Journal of Chemical Physics, The ;* **74**: No. 5, 2808-2818(1 Mar 1981).

Irradiating a spin system with an appropriate sequence of phase shifted pulses excites only certain orders of multiple-quantum transitions excited. Using such sequences in preparation and detection produces a large signal/noise enhancement for the multiple-quantum spectra over nonselective excitation, as predicted from theory. In a previous paper the theory was presented in detail. In this paper some aspects of the theory are first outlined briefly. Experimental results are then presented demonstrating four-quantum, six-quantum, and A-symmetry selection in oriented benzene and eight-quantum selection in oriented 1-bromobutane. A six-quantum selective sequence applied to benzene with nonequilibrium initial reduced density matrix proportional to I/sub x/ produces one- and five-quantum spectra. The n-quantum signal/noise enhancements are obtained and the selectivity is measured as a function of pulse sequence parameters. The behavior is that expected if one assumes that the limit to selectivity is determined by leading nonselective terms in an average Hamiltonian expansion.

17618 **Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O.** Armentrout, P.B.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *Journal of Chemical Physics, The ;* **74**: No. 5, 2819-2826(1 Mar 1981).

An ion beam apparatus is employed to study the formation of the cobalt carbene ion, $CoCH_2^+$. This ion is produced in the endothermic reaction of cobalt ions with ethene and cyclopropane and in an exothermic reaction with ethylene oxide. A model is proposed to account for the dependence of experimental cross sections on relative kinetic energy for the endothermic reactions. Using this model to interpret the experimental results, a bond dissociation energy D °(Co^+-CH_2) = 3.7 +- 0.3 eV is derived.

17619 **Collisional decomposition of UF_6p.** Haywood, S.E.; Doverspike, L.D.; Champion, R.L.; Herbst, E.; Annis, B.K.; Datz, S. (College of William and Mary, Williamsburg, VA). *Journal of Chemical Physics, The ;* **74**: No. 5, 2845-2852(1 Mar 1981).

Absolute cross sections for the collisional decomposition of UF_6^- into its three lowest asymptotic channels in collisions with the rare gases have been measured for collision energies ranging from below the threshold for decomposition up to a laboratory collision energy of 500 eV. The product velocity spectra have also been measured for one of the decomposition channels at the highest collision energy. The experimental results are found to be consistent with the predictions of a two-step collision model where the unimolecular decomposition of excited UF_6^- ions is described in a statistical framework.

17620 **MQDT analysis of predissociation. I. A two channel problem with semiclassical scattering parameters.** Colle, R. (Univ. of Chicago, IL). *Journal of Chemical Physics, The ;* **74**: No. 5, 2910-2919(1 Mar 1981).

Diatomic predissocitaion (case I) is treated in the framework of the multichannel quantum defect theory (MQDT) by adapting the Child and Bandrauk formulation. Analytical expressions are given for the scattering parameters of a two channel problem in terms of WKB phase integrals and of crossing parameters. Resonances in scattering and photoabsorption spectra are identified as the points of steepest rise of an effective phase shift, and analytical expessions are derived for both linewidths and energy shifts. A sample calculation shows the effects of coupling with the $B\ ^3\Sigma^-$/sub u/ state upon the partial elastic cross section of two oxygen atoms colliding in the ^{5}Pi/sub u/ channel.

17621 **Spectroscopic B/sub v/ constants for Rydberg states of D_3.** Carney, G.D. (Brookhaven National Lab., Upton, NY). *Journal of Chemical Physics, The ;* **74**: No. 5, 3076-3078(1 Mar 1981).

Theoretical spectroscopic B/sub v/ values for several low lying levels of vibration in 14 Rydberg electronic states of D_3 are reported. Addition of excitation increments δB/sub v/ to the B_0 (zero-point state) reported previously allowed calculation of B/sub v/ = B_0 + δB/sub v/ for Rydberg states of D_3. These are the first theoretical predictions for these quantities to become available.

17622 **Dissociation energies of molecules with very heavy atoms from mass spectrometry.** Pitzer, K.S. (Lawrence Berkeley Lab., CA). Contract W-7405-ENG-48. *Journal of Chemical Physics, The ;* **74**: No. 5, 3078-3079(1 Mar 1981).

For Pb_2 and BiLi, it is shown that relativistic effects yield large spin-orbit splittings and thus reduce the electronic partition function by significant amount. Since the partition function is required for dissociation energy calculations from mass spectrometric data, caution is advised in choosing the electronic partition function.

17623 **Energy and angular distributions of electrons from fast He^+ /He collisions.** Manson, S.T.; Toburen, L.H. (Department of Physics and Astronomy, Georgia State University, Atlanta, Georgia 30303). DE-AC06-76RLO-1830. *Physical Review Letters ;* **46**: No. 8, 529-531(23 Feb 1981).

The first realistic calculations of the energy and angular distributions of electrons ejected in ion-atom collisions, where the ion carries along its own electrons, are presented. The calculations, within the Born-approximation framework, have been performed for He^+ +He collisions, and measurements have also been made. Rather good quantitative agreement between our measurements and calculations has been obtained over a broad range of energies and angles. Some difficulties persist, however, near the forward direction.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 16943

17624 **(ANL/MHD—81-2) Particulate deposition from turbulent parallel streams.** Im, K.H.; Chung, P.M. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01.

A theory is developed for particulate deposition rate on surfaces from turbulent gas streams. The three characteristic times, the particle equilibration time, the turbulent fluctuation time, and the particle residence time, control the deposition mode. The larger particles reach the wall across the laminar sublayer because of the

momentum imparted to them by the turbulence velocity of the fluid. The smaller particles, on the other hand, diffuse to the wall by thermophoresis which depends on the temperature gradient. The computed results of the theory for pipe flow are compared with the available experimental data and satisfactory agreement is shown.

17625 **(UCRL—85677-VUGRAPH) Application program performance measurements.** Rudy, T. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1981. Contract W-7405-ENG-48. 46p. (CONF-810334—1). NTIS, PC A03/MF A01.

From Workshop on high speed computing; Gleneden Beach, OR, USA (31 Mar 1981).

The viewgraphs from a talk on measurement of performance of applications programs are given. The area of interest is hydrodynamics. Only the viewgraphs are included; there is no text. (RWR)

17626 **Physical optics of the laser-schlieren shock tube technique.** Kiefer, J.H.; Al-Alami, M.Z.; Hajduk, J. (Univ. of Illinois, Chicago). Contract ER-78-S-502-4759. *Applied Optics ;* **20**: No. 2, 221-230(15 Jan 1981).

The physical optics of the laser-schlieren technique for the measurement of rate processes in shock waves is examined in detail. The method utilized the Kirchhoff-Hyggens integral with the usual thin lens, paraxial, and Fresnel approximations, all of which are appropriate for the typical laser schlieren experiment. The resolution and sensitivity of the technique are defined for all detector separations, and a reliable method for locating the time origin in the schlieren signal is provided. Diffraction is found to have a significant effect on the shock front generated signal, and geometrical optics treatments of this signal are shown to be inadequate.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 17304

17627 **(BNL—29072) Way to observe the Higgs boson H^0 in hadronic interactions.** Chau Wang, L.L. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 7p. (CONF-801244—4). NTIS, PC A02/MF A01.

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

With its single parameter $\sin^2 \theta$/sub W/ = .23 +- .02, the standard SU(2) x U(1) model has impressively fitted many different types of weak interactions. Though the model has the definite predictions of the intermediate bosons W^{+-}, Z^0, with Masses M/sub W/ ≅ 80 GeV, M/sub Z/ ≅ 90 GeV, the mass-generating mechanism of the theory has been obscure. Since we are at the threshold of checking the existence of the predicted W^{+-} and Z^0 with definite signatures in the next generation accelerators, it is of great importance to find ways to check the existence of these mass-generating related bosons. Contrasting to the situation with e^+e^- machines, for which signatures and ways to observe such bosons are rather clear, ways of detecting such bosons have been noticeably missing in hadronic scatterings. Here it is pointed out that the bremsstrahlung of the H^0 by a Z^0, produced in hadronic scattering gives a definite signature of a bump in the dilepton mass Q with a sharp fall at Q ≅ M/sub Z/ - M/sub H/. The production is calculated using the Drell-Yan model.

17628 **(DOE/ER/01764—397) Polarization in inclusive lambda production.** Heller, K. (Minnesota Univ., Minneapolis (USA)). 1981. Contract AC02-76ER01764. 7p. NTIS, PC A02/MF A01.

At high energies the reaction p + N → Λ^0 + X yields Λ^0s which are strongly polarized. The behavior of this polarization should give information about quark production mechanisms. The inclusive Λ^0 polarization is also compared with anti Λ^0, and proton polarization in the fragmentation region of the incident proton at Fermilab energies.

17629 **(DOE/ER/02232—97) Recent results from the CFRR neutrino experiment at Fermilab.** Barish, B.; Blair, B.; Chu, Y. (California Inst. of Tech., Pasadena (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA); Rockefeller Univ., New York (USA)). 1980. Contract AC02-76ER02232. 23p. (CONF-800724—75). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Preliminary results from a new high-statistics study of neutrino and antineutrino interactions are presented. The full data sample includes 130,000 charged-current neutrino and 23,000 antineutrino events detected in the large-acceptance Lab E neutrino target at Fermilab with the N-30 dichromatic beam. Results based on a preliminary sample of one-third of the data are given for normalized cross sections, neutral currents, and like-sign dimuons.

17630 **(DOE/ER/03072—T3) Charm production by muons and its role in scale-noninvariance.** Gollin, G.D. (Princeton Univ., NJ (USA). Dept. of Physics). Jan 1981. Contract AC02-76ER03072. 257p. NTIS, PC A12/MF A01.

Thesis.

Interactions of 209 GeV muons in the Multimuon Spectrometer at Fermilab have yielded more than 8 x 10^4 events with two muons in the final state. After reconstruction and cuts, the data contain 20,072 events with (81 +- 10)% attributed to the diffractive production of charmed states decaying to muons. The cross section for diffractive charm muoproduction is 6.9(+1.9,-1.4) nb where the error includes systematic uncertainties. Extrapolated to $Q^2 = 0$ with sigma(Q^2) = sigma(0)$(1 + Q^2/\Lambda^2)^{-2}$, the effective cross section for 178 (100) GeV photons is 750(+180,-130) (560(+200,-120)) nb and the parameter Λ is 3.3 +- 0.2 (2.9 +- 0.2) GeV/c. The ν dependence of the cross section is similar to that of the photon-gluon-fusion model. A first determination of the structure function for diffractive charm production indicates that charm accounts for approximately 1/3 of the scale-noninvariance observed in inclusive muon-nucleon scattering at low Bjorken x. Okubo-Zweig-Iizuka selection rules and unitarity allow the muon data to set a 90%-confidence lower limit on the psi N total cross section of 0.9 mb.

17631 **(LBL—12275) Possible deviations from (V-A) charged currents: precise measurement of muon decay parameters.** Strovink, M. (California Univ., Berkeley (USA)). Feb 1981. Contract W-7405-ENG-48. 27p. (CONF-801244—5). NTIS, PC A03/MF A01.

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

This short review examines the experimental limits on possible deviations from (V-A) charged weak currents, as would occur at some mass scale, for example, in manifestly left-right-symmetric electro-weak theories. Both present and anticipated limits are considered, emphasizing muon-decay experiments but including other experimental input where convenient.

17632 **(SLAC—239) Proceedings of Summer Institute on Particle Physics: the weak interaction.** Mosher, A. (ed.). (Stanford Linear Accelerator Center, CA (USA)). Jan 1981. Contract AC03-76SF00515. 631p. (CONF-800782—). NTIS, PC A99/MF A01.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The SLAC Summer Institute on Particle Physics held its eighth session on July 28-August 8, 1980, and the focus of the meeting was The Weak Interaction. Following the now traditional format, the first seven days of the Institute were spent with the mornings given to pedagogic lectures on the experimental and theoretical foundations of the topic. This year included a very stimulating and successful series on the physics of particle detectors. In the afternoons were seminars on the various experimental tools being designed or constructed to further probe the Weak Interaction, followed by lively discussion of the morning's lectures. Again, following the usual format, the school led into a three-day topical conference at which the most recent theoretical and experimental results were presented and discussed. Abstracts of twenty-seven items from the Institute were prepared separately for the data base.

17633 (SLAC—239, pp 349-359) **Brief review of recent results from the crystal ball detector at SPEAR.** Bloom, E.D. (Stanford Univ., CA). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Experimental results and performance of the crystal ball detector at SPEAR are summarized. The measuremements include: inclusive photon spectra from J/PSI and PSI' decays; photon cascades of the PSI'; three-γ decays of J/PSI and PSI'; and inclusive eta meson production. (GHT)

17634 (SLAC—239, pp 441-456) **Neutrino instability.** Sobel, H.W.; Reines, F.; Pasierb, E. (Univ. of California, Irvine). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Indications of neutrino instability were obtained from data on the processes. Although the deuteron reaction is not the ideal way to search for neutrino oscillations, it has a number of attractive features which allow us to side step many of the problems currently inherent in reactor neutrino studies. The reactor is a good source since it provides a very intense (2 x 10^{15} anti ν/sub e/$cm^{-2}sec^{-1}$) pure source of anti ν/sub e/'s at low energies (< 10 MeV). The difficulty has been the uncertainty in the anti ν/sub e/ spectrum.

17635 (SLAC—239, pp 457-474) **Review of proton decay experiments.** Vander Velde, J.C. (Univ. of Michigan, Ann Arbor). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Preparations going on around the world to measure the lifetime for nucleons to decay via baryon number violating modes are reviewed.

17636 (SLAC—239, pp 475-486) **Recent results from the CFRR neutrino experiment at Fermilab.** Barish, B. (Univ. of California, Pasadena); Blair, B.; Chu, Y. Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Preliminary results from a new high-statistics study of neutrino and antineutrino interactions are presented. The full data sample includes 130,000 charged-current neutrino and 23,000 antineutrino events detected in the large-acceptance Lab E neutrino target at Fermilab with the N-30 dichromatic beam. Results based on a preliminary sample of one-third of the data are given for normalized cross sections, neutral currents, and like-sign dimuons.

17637 (SLAC—239, pp 487-503) **Some results from the charm neutrino experiment at the CERN SPS.** Niebergall, F. (Univ. of Hamburg, Germany). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The electronics detector of the CHARM Collaboration has been taking data for about two years in the CERN SPS narrow- and wide-band neutrino beams (NBB and WBB). It was designed for a variety of applications which make it particular and different from other devices used in this field. The special features of this detector are discussed, along with a discussion of physics results.

17638 (SLAC—239, pp 505-519) **Results from the CDHS neutrino experiment.** Geweniger, C. (Inst. fuer Hochenergiephysik der Universitaet, Heidelberg, Germany). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Latest results from the CERN-Dortmund-Heidelberg-Saclay neutrino experiment at the CERN SPS are reported. The detector consists of a magnetized iron calorimeter equipped with drift chambers to measure muon momenta and shower energies from neutrino interactions in iron. The topics covered by this talk are a beam dump experiment, the determination of nucleon structure functions from inclusive charged current interactions with an isoscalar target, and the analysis of opposite sign dimuon events. The data to be presented here are improved over previously published data of this group from the statistical and the systematical point of view. Except for the beam dump experiment the results are mostly preliminary.

17639 (SLAC—239, pp 521-538) **Results fron CERN muon scattering experiments.** Montgomery, H.E. (CERN, Geneva, Switzerland). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The status of experiments involved in muon scattering at CERN is reviewed. Special emphasis is given to recent results.

17640 (SLAC—239, pp 539-558) **Virtual photoproduction of hidden and open charm.** Clark, A.R. (Univ. of California, Berkeley); Johnson, K.J.; Kerth, L.T. Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The Berkeley-Fermilab-Princeton multimuon spectrometer and the techniques used to analyze the data which it has collected are described. The first physics topic is relevant to weak interactions, the subject of this conference. Limits are presented on the cross section with which possible heavy neutral or doubly charged muons are produced via right-handed charged currents. The relevant phenomenology of heavy quark muoproduction is outlined, emphasizing the predictions of the vector dominance (VMD) and photon-gluon-fusion (γGF) models. The first heavy-quark data discussed are the dimuon-mass spectrum observed in trimuon final states, which provides a published limit on muoproduction of the Y family. The bulk of the quarkonium results is devoted to J/psi(3100) muoproduction. After briefly reviewing the original psi results, a combined analysis is given of the polarization and Q^2-dependence of elastically produced psi's. The balance of the talk is devoted to the muoproduction of open charm, observed in events with two muons in the final state.

17641 (SLAC—239, pp 573-599) **Review of experiments on charmed particle lifetimes.** Mulvey, J.H. (Univ. of Oxford, England). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The lifetimes, branching ratios, decay modes, masses and other properties of charmed particles have a bearing on several fundamental questions of physics. An accurate measurement of the lifetime, together with the leptonic branching ratio, is required for the determination of Kobayashi-Maskawa mixing angles, which contain clues on the symmetry breaking mechanism responsible for fermion masses. The decay modes also provide another window on the character of the quark-gluon interaction and its description in terms of QCD. This review surveys recent experiments aimed at a determination of mean lifetimes and, in particular, considers the performance of some current and proposed techniques for the detection of short-lived particles.

17642 **(UCR—34P107-263) High energy physics annual report, January 1, 1979-December 31, 1979.** Kernan, A.; Poe, R.T. (California Univ., Riverside (USA)). Dec 1979. Contract AT03-76ER70107. 33p. NTIS, PC A03/MF A01.

Research during 1979 is reported in the areas of: high energy heavy ion physics; the lampshade magnet; a general PEP detector based on the time projection chamber; and proton-antiproton interactions at cm energy of 600 GeV. (GHT)

17643 **Upper limits on phiphi production in 350-GeV/c proton-beryllium collisions.** Yamanouchi, T.; Brown, B.C.; Brown, C.N.; Dixon, R.L.; Ito, A.S.; Jostlein, H.; Lederman, L.M.; Ueno, K.; Coutrakon, G.B.; Finley, D.A.; McCarthy, R.L. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review, The, D. Particles and Fields ;* **23**: No. 7, 1514-1516(1 Apr 1981).

We have established a sensitive upper limit on phiphi resonance production by 350-GeV/c protons incident on a beryllium target. The 90%-confidence-level upper limit varies from 1.5 x 10^{-30} cm^2/nucleon at M/sub phiphi/=2.8 GeV/c^2 to 6.0 x 10^{-32} cm^2/nucleon at M/sub phiphi/=3.4 GeV/c^2. We observe no evidence of the eta/sub c/.

17644 Single and double pion production from 800 MeV proton-proton collisions. Cverna, F.H.; Bevington, P.R.; McNaughton, M.W.; Willard, H.B.; King, N.S.P.; Giebink, D.R. (Case Western Reserve University, Cleveland, Ohio 44106). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1698-1705(Apr 1981).

The three-body final-state reaction of charged single-pion production, pp→π^+ pn, and that for charged double-pion production, pp→$\pi^-\pi^+$ pp, have been studied at T/sub P/=800 MeV by measuring the momentum spectra for π^+ and π^- emitted from proton-proton collisions. The momentum spectra for single-pion production are fit with the peripheral model calculations of Ver-West, and a similar model by one of us is discussed. The spectra for double-pion production follow an extrapolation of the Lindenbaum and Sternheimer model from higher energies toward threshold. This result is in disagreement with the results of Cochran et al.

17645 Theoretical and experimental review of the weak neutral current: a determination of its structure and limits on deviations from the minimal SU(2)/sub L/ x U(1) electroweak theory. Kim, J.E.; Langacker, P.; Levine, M.; Williams, H.H. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). EY-76-02-3071. *Reviews of Modern Physics ;* **53**: No. 2, 211-252(Apr 1981).

A detailed analysis of existing neutral-current data has been performed in order (a) to determine as fully as possible the structure of the hadronic and leptonic neutral currents without recourse to a specific weak-interaction model; (b) to search for the effects of small deviations from the Weinberg-Salam (WS-GIM) model; and (c) to determine the value of $\sin^2\theta$/sub w/ as accurately as possible. The authors attempt to incorporate the best possible theoretical expressions in the treatment of each of the reactions. For deep-inelastic scattering, for example, the effects of quantum chromodynamics, including the contributions of the s and c quarks, have been included. The sensitivity of the results both to systematic uncertainties in the data and to theoretical uncertainties in the treatment of deep-inelastic scattering, semi-inclusive pion production, ν elastic scattering from protons, and the asymmetry in polarized eD scattering have been considered; the systematic errors are generally found to be smaller than the statistical uncertainties. In the model-independent analyses the authors find that the hadronic neutral-current parameters are uniquely determined to lie within a small domain consistent with the WS-GIM model. The leptonic couplings are determined to within a twofold ambiguity; one solution, the axial-vector-dominant, is consistent with the WS-GIM model. If factorization is assumed then the axial-dominant solution is uniquely determined and null atomic parity violation experiments are inconsistent with other neutral-current experiments. Within generalized SU(2) x U(1) models we find the following limits on mixing between right-handed singlets and doublets: $\sin^2\alpha$/sub u/< or =0.103, $\sin^2\alpha$/sub d/< or =0.348, and $\sin^2\alpha$/sub e/< or =0.064.

17646 Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets. Yung, K.W. Pasadena, CA; California Inst. of Technology (1980). 214p. University Microfilms Order No. 80-06,723.

Thesis (Ph. D.).

High-transverse-momentum (p/sub perpendicular to/) particles are thought to reflect the underlying parton (quark or gluon) mechanisms of hadron interactions. A particularly simple model by Feynman, Field, and Fox (or FFF) involves hard scattering of a pair of partons via gluon exchange (QCD) with subsequent fragmentation of the partons into hadrons. Results on the production of jets (groups of particles) and single charged particles, at both low and high p/sub perpendicular to/, in 200-GeV interactions are presented. The experiment used a calorimeter-triggered multiparticle spectrometer. Results are presented on the comparisons of cross sections and associated charged particle distributions. The high-p/sub perpendicular to proton data agree with the FFF predictions in most cases; however, there are signs of discrepancies. α is defined by: A/sub AL//sup α/ = σ/sub AL/σ/sub Hγ/, where A/sub AL/ is the atomic weight of aluminum and σ/sub AL/ and σ/sub Hγ/ are cross sections for the aluminum and hydrogen targets. The proton beam data show larger nuclear anomalies (in particular, α > 1) than the pion beam data. There is essentially no difference between π^+ and π^- beams. The associated charged particle distributions for the two targets are compared. The observed difference between these two targets could be related to the propagation and secondary scattering of partons in the nuclear matter; in this interpretation, any secondary scattering must be coherent with the main interaction.

17647 Dimuon production by high energy neutrino and antineutrino nucleon collisions. Winn, D.R. Madison, WI; Univ. of Wisconsin (1979). 299p. University Microfilms Order No. 80-01,644.

Thesis (Ph. D.).

An experiment measuring the rates and properties of opposite-sign dimuons produced by muon neutrino- and antineutrino-nucleon collisions is reported. The hadronic energy and the momentum vectors of the two muons were measured by use of the techniques of calorimeter targets and solid iron toroidal magnetic spectrometers. The experiment used broad-band neutrino beams at Fermilab. A comparison of the dimuon data is made with a model for charm meson weak production and semileptonic decay, showing good agreement between theory and data with appropriate choices of parameters. Other sources of dimuon final states in neutrino-nucleon scattering are discussed. In particular, the mechanisms and implications of b-quark production to dimuon data are examined.

17648 Search for exotic meson production at 13 GeV/c in the reaction pi-n → p/sub (forward)/X--. Kreymer, A.E. Bloomington, IN; Indiana Univ. (1979). 176p. University Microfilms Order No. 80-08,219.

Thesis (Ph. D.).

Recent developments in elementary particle theory suggest the possible existence of four-quark, or exotic, mesons. Such mesons can have quantum numbers not possible for normal mesons, which appear to be formed from only two quarks. This experiment, conducted at the Stanford Linear Accelerator Center, is designed to search for narrow, doubly charged mesons produced in the channel pi-n → p/sub (forward)/X--. A pion secondary beam, having a momentum of 13 GeV/c, is focused on a liquid deuterium target, located in the SLAC Two Meter Streamer Chamber. Forward proton events are detected by a spectrometer system consisting of a large-aperture magnet, two scintillation counter hodoscopes, twenty-four planes of wire spark chambers, and a threshold Cerenkov counter. This system has a good acceptance for a mass range of 1.5 to 3.5 GeV, and a range of (t-tmin) of up to 0.3 GeV. Results are examined in the missing mass and inclusive spectra. A strong feature of the data is the forward production of N^* in all channels. The forward production of proton-antiproton systems, with a mass of 2.1 GeV, accounts for a third of all two-prong events, and is also seen in the three-prong data. Evidence for manifest (X--) exotics is not present in the missing mass or inclusive spectra. Final conclusions cannot be reached regarding fit states, because a systematic error in the beam momentum remains to be corrected. Resonant structure may be present in the antiproton-neutron system, produced against forward ($p\pi^-$).

17649 Measurement of the decay rate of the Dalitz decay of the neutral pion. Schardt, M.A. Tempe, AZ; Arizona State Univ. (1979). 179p. University Microfilms Order No. 80-06,383.

Thesis (Ph. D.).

A measurement of the decay rate of the Dalitz decay mode ($\pi^0 \rightarrow \gamma e^+ e^-$) of the neutral pion has been made at the High Energy Pion channel of the LAMPF accelerator in Los Alamos. The neutral pions were produced via the charge exchange process, $\pi^- p \rightarrow \pi^0 n$, by placing several thicknesses of polyethelene targets in a collimated π^- beam. The decay leptons were detected in coincidence with the photon in a magnetic spectrometer. The yields per target thickness were extrapolated to zero target thickness, and the result was normalized to the primary decay mode ($\pi^0 \rightarrow \gamma\gamma$). A Monte Carlo computer simulation was used to simulate carefully the two decay processes and the response of the apparatus. The branching ratio, $R = \Gamma(\pi^0 \rightarrow \gamma e^+ e^-)/\Gamma(\pi^0 \rightarrow \gamma\gamma)$, was measured to be $R = (1.24 \pm 0.04) \times 10^{-2}$.

17650 Search for parity non-conservation polarized proton-nucleon scattering at 6 GeV/c. Alde, D.M. Urbana, IL; Univ. of Illinois (1979). 92p. University Microfilms Order No. 80-08,957.

Thesis (Ph. D.).

An experiment has been performed at the Argonne National Laboratory Zero Gradient synchrotron to measure the dependence of the total proton-nucleon cross section on the helicity of the incident proton. A dependence of the total cross section on the proton helicity is a measure of the strength of the weak interaction in the hadronic system. The cross section was determined by measuring the transmission of 6-GeV/c polarized protons through an H_2O target. Integral counting techniques were used to achieve the high data rates required for the measurement of the small effect. The measured cross section asymmetry (σ/sub +/ - σ/sub -/)/(σ/sub +/ + σ/sub -/) - (-26.3 +- 7.5) x 10^{-6}, where σ/sub +/(σ/sub -/) is the total cross section for positive-(negative-) helicity protons incident on an H_2O target. The asymmetry is substantially larger than predicted by conventional theories of the weak interaction. Systematic contributions to the asymmetry are discussed. This result may include systematic contributions that were not measured or were measured inadequately by the apparatus. Suggestions for improving the experiment are made. Preliminary results for the asymmetry from the improved version of the experiment are given that are consistent with zero.

17651 **Bremsstrahlung process in electron positron colliding beams.** Biddick, C.J. San Diego, CA; Univ. of California (1979). 113p. University Microfilms Order No. 80-02,929.

Thesis (Ph. D.).

Yields for the e^+e^- bremsstrahlung process were measured using data collected at the Stanford Linear Accelerator Center's electron-positron colliding beam storage ring, SPEAR. Large sodium iodide crystals, lead-scintillator shower counters, and drift chambers were used to detect the particles. Also studied was the mass spectrum of the internal lepton line. No disagreement with QED was found when both electrons were detected with low angles; but when one electron was detected at greater than 15 degrees, the data did not agree with the Monte Carlo calculation.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 17645, 17680

17652 **(ANL-HEP-CP—80-60) QCD corrections to quarkonia decays.** Celmaster, W. (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 13p. (CONF-800724—73). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

A summary is given of recent work done on QCD corrections to inclusive leptonic and hadronic decays of quarkonia. Particular attention is given to the decays psi→e^+e^- and n/sub Q/→ hadrons.

17653 **(ANL-HEP-CP—80-64) Why most flavor-dependence predictions for nonleptonic charm decays are wrong: flavor symmetry and final-state interactions in nonleptonic decays of charmed hadrons.** Lipkin, H.J. (Fermi National Accelerator Lab., Batavia, IL (USA); Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 24p. (CONF-8009139—1). NTIS, PC A02/MF A01.

From International School of Subnuclear Physics conference; Geneva, Switzerland (Sep 1980).

Nonleptonic weak decays of strange hadrons are complicated by the interplay of weak and strong interactions. Models based either on symmetry properties or on the selection of certain types of diagrams are both open to criticism. The symmetries used are all broken in strong interactions, and the selection of some diagrams and neglect of others is never seriously justified. Furthermore, the number of related decays of strange hadrons is small, so that experimental data are insufficient for singificant tests of phenomenological models with a few free parameters. The discovery of charmed particles with many open channels for nonleptonic decays has provided a new impetus for a theoretical understanding of these processes. The GIM current provides a well defined weak hamiltonian, which can justifiably be used to first order. The QCD approach to strong interactions gives flavor-indpendent couplings and flavor symmetry broken only by quark masses. In a model with n generations of quarks and 2n flavors, a flavor symmetry group SU(2n) can be defined which is broken only by H/sub weak/ and the quark masses.Here again, the same two approaches by symmetry and dynamics have been used. But both types of treatment tend to consider only the symmetry properties or dominant diagrams of the weak interaction, including some subtle effects, while overlooking rather obvious effects of strong interactions.

17654 **(DOE/ER/01545—289) Neutrino mixing in a grand unified theory.** Milton, K.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1980. Contract AC02-76ER01545. 6p. NTIS, PC A02/MF A01.

Neutrino mixing in a grand unified theory in which the neutrino mass matrix is determined by the Gell-Mann-Ramond-Slansky mechanism was investigated. With an arbitrary real right-handed Majorana mass matrix which incorporates three neutrino mass scales, the effects of the up-quark mass matrix are found to be dominant and as a result no significant mixing of ν/sub e/ occurs, while ν/sub μ/ - ν/sub γ/ mixing can be substantial.

17655 **(DOE/ER/10402—T1) Pion-nucleon partial wave analysis and study of baryon structure. Progress report, June 1, 1979-May 31, 1981.** Hendrick, R.E. (Saint Bonaventure Univ., NY (USA)). 10 Jan 1981. Contract AS02-79ER10402. 21p. NTIS, PC A02/MF A01.

This report details progress toward completion of a long-term pion-nucleon partial wave analysis, summarizing results and conclusions to date. The report also discussed progress in using partial wave and resonance parameter results to test dynamical models of the baryon and in better understanding interquark forces within baryons.

17656 **(FERMILAB-Conf—80/86-THY) Electroweak interactions.** Bjorken, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1980. Contract AC02-76CH03000. 67p. NTIS, PC A04/MF A01.

A point of view of the electroweak interaction is presented. It begins phenomenologically and moves in stages toward the conventional gauge theory formalism containing elementary scalar Higgs-fields and then beyond. The purpose in so doing is that the success of the standard SU(2) x U(1) theory in accounting for low energy phenomena need not automatically imply success at high energies. It is deemed unlikely by most theorists that the predicted W^{+-} or Z^0 does not exist or does not have the mass and/or couplings anticipated in the standard model. However, the odds that the standard predictions will work are not 100%. Therefore there is some reason to look at the subject as one would were he forced by a wrong experimental outcome - to go back to fundamentals and ascertain what is the minimal amount of theory necessary to account for the data.

17657 **(IS-T—929) Study of different forms for the recombination function in the formation of mesons from partons.** Groessing, G. (Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-82. 56p. NTIS, PC A04/MF A01.

The form of the recombination function R is varied phenomenologically, and moment solutions are given for the fragmentation function implied by these different R functions. The fragmentation functions calculated from their moments by the moment inversion method of Yndurain are represented for comparison with experimental data. A description is given of the quark recombination model, and choices are mentioned for the recombination function in meson production, introducing an expression for R and giving a general moment solution for the fragmentation function. (GHT)

17658 (SLAC—239, pp 1-27) **Gauge theories of weak interactions.** Veltman, M.J. Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The purpose of these notes is to produce an introduction to the presently popular standard model of weak and electromagnetic interactions. This model has a number of ingredients, leptons, quarks, vector bosons, photons and finally also Higgs scalars, and of these only the leptons and photons are directly observed particles. The evidence for quarks comes from another domain of physics, namely strong interactions supposedly described by quantum chromodynamics. The massive vector bosons as well as the Higgs

particles are theoretical inventions, and while few people doubt the existence of vector bosons, many are skeptical with respect to the Higgs system. Meanwhile, theorists have gone beyond the standard model, and speculations on possible grand unified schemes have emerged. Also there are speculations on the possible compositeness of quarks and leptons, or Higgs particles.

17659 (SLAC—239, pp 29-66) **Neutrinos and neutrino interactions.** Sciulli, F. (California Inst. of Tech., Pasadena). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

A review is given of knowledge of the interactions that produce neutrinos and through which they are influenced. Following this is a brief discussion on the nature of the neutrinos themselves.

17660 (SLAC—239, pp 67-140) **Weak decays of strange and heavy quarks.** Hitlin, D.G. (California Inst. of Tech., Pasadena). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Weak decays of strange, charmed, bottom and top quarks are discussed in the context of the Kobayashi-Maskawa six quark model. Determination of the K-M mixing angles is reviewed. Experimental information on weak decays of charmed particles and bottom mesons is summarized. The resulting phenomenology is shown to be inconsistent with the naive light quark spectator model of charmed particle decay, and some of the consequences of alternative models are considered. Explicit QCD based estimates of decay diagrams are discussed, with emphasis on the origin of the $\Delta I = 1/2$ rule, understanding of Cabibbo-suppressed charm decays and CP violation. Further experimental results which are necessary to arrive at a clear understanding of these weak decay processes are considered. 128 references.

17661 (SLAC—239, pp 141-175) **From the standard model to composite quarks and leptons. Part I. Standard model, its present status and its open problems. Part II. Composite quarks and leptons.** Harari, H. (Weizmann Inst. of Science, Rehovot, Israel). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Topics covered include: the framework of the standard model; the parameters of the standard model; additional aspects of the model; and the generation puzzle. The values of the known parameters and experimental means of studying the undetermined parameters are discussed. It is clear that a theory with more than 30 parameters cannot be considered to be completely satisfactory, which motivates going beyond the standard model. 24 references. (GHT)

17662 **Second-order quantum-chromodynamic effect in J/psi photoproduction.** Tajima, T.; Watanabe, T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). DE-AC03-76SF00515. *Physical Review, The, D. Particles and Fields ;* **23**: No. 7, 1517-1520(1 Apr 1981).

Second-order quantum-chromodynamics (QCD) contributions are calculated for J/psi photoproduction. We show that the measurement of the nonforward structure of the cross section $d\sigma/dt$ at large -t (> or =1 GeV^2) could be an excellent test for QCD.

17663 **Inelastic photoproduction of J/psi and Y by gluons.** Berger, E.L.; Jones, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review, The, D. Particles and Fields ;* **23**: No. 7, 1521-1530(1 Apr 1981).

Amplitudes are derived for the quantum-chromodynamic subprocess $\gamma g \rightarrow (J/psi)g$, with a specific wave function used to represent the J/psi as a cc-bar system. The results are used to obtain the normalized total cross section $\sigma/sub\ \gamma/$ for the inelastic process $\gamma N \rightarrow (J/psi)X$, predictions for the z and p/sub T/ dependence of inelastic J/psi photoproduction, and predictions for the J/psi helicity. The predictions apply as well to electroproduction at small Q^2.

17664 **Three-body decays of the proton.** Wise, M.B.; Blankenbecler, R.; Abbott, L.F. (Department of Physics, Harvard University, Cambridge, Massachusetts 02138). DE-AC03-76SF00515. *Physical Review, The, D. Particles and Fields ;* **23**: No. 7, 1591-1598(1 Apr 1981).

The rates for the three-body proton decays $p \rightarrow \pi\pi e^+$ are related to the rate for the decay $p \rightarrow \pi^0 e^+$. This is done by making an ansatz for the form of the three-body amplitude which is consistent with current algebra and with the measured $\pi\pi$ final-state interactions. We find that the three-body decay rates are comparable with the rate for the two-body decay $p \rightarrow \pi^0 e^+$.

17665 **Two-jet decay of particles with heavy quarks.** Rizzo, T.G. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Physical Review, The, D. Particles and Fields ;* **23**: No. 7, 1599-1603(1 Apr 1981).

We examine the possibility that heavy quarks may have significant two-jet decays resulting from the process h→l+gluon with h (l) being the initial (final) heavy (light) quark in addition to the usual three-jet decay process h→qq-barq. The process h→l+g is found to occur with a branching ratio ≅10% for b-quark decay and ≅1% for t-quark decay (for m/sub t/≅25 GeV).

17666 **Quark masses and renormalization-scheme dependence in quantum chromodynamics.** Coquereaux, R. (Harvard Univ., Cambridge, MA). Contract DE-AS02-76ER03227;DE-AC02-76CH00016. *Physical Review, The, D. Particles and Fields ;* **23**: No. 6, 1365-1374(15 Mar 1981).

Discussed is the quark-mass dependence appearing in the several renormalization schemes of quantum chromodynamics. Then we introduce scheme-independent quantities which can be used in order to compare different schemes. Finally, by using these quantities we recover the results of effective gauge theories.

17667 **How to calculate the heavy-quark fragmentation function: an application of cut vertices.** Oliensis, J. (Fermi National Accelerator Laboratory, Batavia, IL). *Physical Review, The, D. Particles and Fields ;* **23**: No. 6, 1430-1440(15 Mar 1981).

It is shown that the heavy-quark fragmentation function is calculable to leading order in the inverse heavy mass. This implies that the production of a heavy particle (with one heavy quark) with a given momentum is calculable. In first approximation the function is $\delta(1-x)$. The peak at $x = 1$ is, however, not of zero width, but has a width on the order of the inverse mass. Determined is the shape of the function for x near 1. Lastly, it is shown that the spin of the heavy quark does not flip during its fragmentation. This paper extends the work of Mueller, Sterman, and others.

17668 **Proton decay rate.** Tomozawa, Y. (Univ. of Michigan, Ann Arbor). *Physical Review Letters ;* **46**: No. 7, 463-467(16 Feb 1981).

The pionic two-body decay amplitude of the proton in the SU(5) grand unified gauge theory is computed by using the soft-pion method in the reference frame of the pion at rest. The normalization condition of the relativistic three-body Bethe-Salpeter wave function of the proton is used in the computation. It is shown that the partial decay rate of the process proton $\rightarrow e + \pi^0$ is $(0.86 \times 10^{30}\ yr)^{-1}$ and $(1.4 \times 10^{31}\ yr)^{-1}$ for m/sub x/ = 4.0×10^{14} GeV and 8.0×10^{14} GeV, respectively. These values are on the boundary of the present experimental limit.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 17562, 17650, 17661, 17664, 17742

17669 **(BNL—29074) Phenomenology of CP violation from the Kobayashi-Maskawa model.** Wang, L.L.C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 14p. (CONF-801244—6). NTIS, PC A02/MF A01.

From Workshop on weak interactions as probes of unification; Blacksburg, VA, USA (3 Dec 1980).

The CP violation consequences of the K-M model, which Kobayashi, Maskawa introduced in 1977 for the purpose of incor-

porating CP violation via the complexity in the mixing matrix of the quarks are discussed. Much of the talk is a review of current work on the subject. Some new results on the CP violation effects in exclusive and inclusive decays of bottom, charm and strange particles are also given.

17670 **(DOE/ER/01545—301) Natural flavor conservation.** Rothman, A.C.; Kang, K. (Ohio State Univ., Columbus (USA). Dept. of Physics; Brown Univ., Providence, RI (USA). Dept. of Physics). 1980. Contract AC02-76ER03130;AC02-76ER01545. 31p. NTIS, PC A03/MF A01.

It is shown that the fiats of Natural Flavor Conservation for an arbitrary U(1)-unbroken gauge theory require that all quarks of a given charge and helicity transform identically under the gauge group.

17671 **(DOE/ER/10587—1) Theoretical studies of high-energy phenomena: analysis of models of CP and T violation. Progress report, February 15, 1980-April 30, 1981.** Sachs, R.G. (Chicago Univ., IL (USA). Enrico Fermi Inst.). Mar 1981. Contract AC02-80ER10587. 6p. NTIS, PC A02/MF A01.

Sum rules for the magnetic moments of the sextet of baryons eta, rho, Σ^-, identicial with ^{0}, identical with $^-$ have been established on the basis of flavor symmetry in the constituent quark models. A significant test of these rules awaits completion of measurements of $\mu(\Sigma^-)$. Consideration has also been given to theoretical implications of the recent suggestion that neutrino experiments show interference between types of neutrino due to mass mixing and that, in particular, the mixing parameter is of the order of one electron volt. The tentative results will be reexamined in detail. The general program on interpretation of CP and T-violation continues as will other studies of high energy phenomena associated with the weak interactions or the structure of hadrons.

17672 (SLAC—239, pp 425-440) **Non-conservation of baryon number.** Zee, A. (Univ. of Pennsylvania, Philadelphia). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

The possibility that baryon number may not be conserved is examined. The experimental and cosmological consequences of this possibility are discussed, emphasizing the various implications baryon number violation would have on the understanding of the physical world.

17673 **CP violation in B-meson decays.** Carter, A.B.; Sanda, A.I. (The Rockefeller University, New York, New York 10021). DE-AC02-76ER02232B. *Physical Review, The, D. Particles and Fields ;* **23**: No. 7, 1567-1579(1 Apr 1981).

The pattern of CP violation in the bottom sector is discussed. We introduce general techniques to expose new CP-violating effects in the cascade decays of B mesons. In the Kobayashi-Maskawa (KM) model, the CP asymmetries so obtained range from 2—20 % for plausible values of the model parameters. This is to be compared with the small effects, of order 10^{-3}—10^{-4}, previously exhibited within this model. Effects of this size should be observable in upcoming experiments. Our approach stresses the on-shell transitions which make up the cascade decays of heavy mesons to ordinary hadrons, as opposed to the off-shell transitions which occur in the analogs of K^0-K-bar^0 mixing. The CP asymmetries generated by our techniques are of order sinδ, where δ is the KM phase angle, and thus represent the maximum effects obtainable in this model.

6454 Field Theory

REFER ALSO TO CITATION(S) 17651, 17657, 17662, 17666, 17667

17674 **(DOE/ER/01764—382) Heavy quarks and new particles.** Rosner, J.L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1979. Contract AC02-76ER01764. 28p. NTIS, PC A03/MF A01.

Some aspects of particles containing c, b, and heavier quarks are reviewed. It is shown how these particles can provide tests of the short-range nature of the strong interactions, and how elementary quantum mechanics can reveal the color and charge of the constituents and the number of states below flavor threshold. Some new results are presented on the inverse problem for confining potentials. Properties of flavored hadrons (masses and lifetimes), of gluonic bound states, and of particles containing very heavy objects are also discussed.

17675 **(DOE/ER/03130—T1) Comparing O(N) and SU(N) x SU(N) spin systems in 1 + 1 dimensions to SU(N) gauge theories in 3 + 1 dimensions.** Shigemitsu, J.; Kogut, J.B.; Sinclair, D.K. (Brown Univ., Providence, RI (USA). Dept. of Physics; Illinois Univ., Urbana (USA). Dept. of Physics). Dec 1980. Contract AC02-76ER03130. 16p. NTIS, PC A02/MF A01.

The scale breaking Λ parameters of the Euclidean and Hamiltonian formulations of the lattice regulated O(N) and SU(N) x SU(N) spin systems in 1 + 1 dimensions were computed in terms of the Λ/sub PV/ parameter of the Pauli-Villars regulated continuum models. Using lattice perturbation theory, the renormalized mass gap has been determined in terms of Λ/sub PV/ for each model. These results are compared to analogous calculations in SU(N) gauge theories.

17676 **(DOE/ER/03130—T2) Study of Λ parameters and crossover phenomena in SU(N) x SU(N) sigma models in two dimensions.** Shigemitsu, J.; Kogut, J.B. (Brown Univ., Providence, RI (USA). Dept. of Physics; Illinois Univ., Urbana (USA). Dept. of Physics). 1981. Contract AC02-76ER03130. 82p. NTIS, PC A05/MF A01.

The spin system analogues of recent studies of the string tension and Λ parameters of SU(N) gauge theories in 4 dimensions are carried out for the SU(N) x SU(N) and O(N) models in 2 dimensions. The relations between the Λ parameters of both the Euclidean and Hamiltonian formulation of the lattice models and the Λ parameter of the continuum models are obtained. The one loop finite renormalization of the speed of light in the lattice Hamiltonian formulations of the O(N) and SU(N) x SU(N) models is calculated. Strong coupling calculations of the mass gaps of these spin models are done for all N and the constants of proportionality between the gap and the Λ parameter of the continuum models are obtained. These results are contrasted with similar calculations for the SU(N) gauge models in 3+1 dimensions. Identifying suitable coupling constants for discussing the $N \rightarrow \infty$ limits, the numerical results suggest that the crossover from weak to strong coupling in the lattice O(N) models becomes less abrupt as N increases while the crossover for the SU(N) x SU(N) models becomes more abrupt. The crossover in SU(N) gauge theories also becomes more abrupt with increasing N, however, at an even greater rate than in the SU(N) x SU(N) spin models.

17677 **(FERMILAB-CONF—80/79-THY) Seven topics in perturbative QCD.** Buras, A.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1980. Contract AC02-76CH03000. 175p. (CONF-800678—3). NTIS, PC A08/MF A01.

From Symposium on topical questions in QCD; Copenhagen, Denmark (9 Jun 1980).

The following topics of perturbative QCD are discussed: (1) deep inelastic scattering; (2) higher order corrections to e^+e^- annihilation, to photon structure functions and to quarkonia decays; (3) higher order corrections to fragmentation functions and to various semi-inclusive processes; (4) higher twist contributions; (5) exclusive processes; (6) transverse momentum effects; (7) jet and photon physics.

17678 **Exact integrability in quantum field theory and statistical systems.** Thacker, H.B. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Reviews of Modern Physics ;* **53**: No. 2, 253-285(Apr 1981).

The properties of exactly integrable two-dimensional quantum systems are reviewed and discussed. The nature of exact integrability as a physical phenomenon and various aspects of the mathematical formalism are explored by discussing several examples, including detailed treatments of the nonlinear Schroedinger (delta-function gas) model, the massive Thirring model, and the six-

vertex (ice) model. The diagonalization of a Hamiltonian by Bethe's Ansatz is illustrated for the nonlinear Schroedinger model, and the integral equation method of Lieb for obtaining the spectrum of the many-body system from periodic boundary conditions is reviewed. Similar methods are applied to the massive Thirring model, where the fermion-antifermion and bound-state spectrum are obtained explicitly by the integral equation method. After a brief review of the classical inverse scattering method, the quantum inverse method for the nonlinear Schroedinger model is introduced and shown to be an algebraization of the Bethe Ansatz technique. In the quantum inverse method, an auxiliary linear problem is used to define nonlocal operators which are functionals of the original local field on a fixed-time string of arbitrary length. The particular operators for which the string is infinitely long (free boundary conditions) or forms a closed loop around a cylinder (periodic boundary conditions) correspond to the quantized scattering data and have a special significance. One of them creates the Bethe eigenstates, while the other is the generating function for an infinite number of conservation laws. The analogous operators on a lattice are constructed for the symmetric six-vertex model, where the object which corresponds to a solution of the auxiliary linear problem is a string of vertices contracted over horizontal links (arrows). The relationship between the quantum inverse method and the transfer matrix formalism is exhibited.

17679 **Tunneling decay of unstable particles in a quantum field theoretic model.** Campbell, D.K. (Los Alamos Scientific Lab., NM). *Annals of Physics (New York)* ; **129**: No. 2, 249-272(15 Oct 1980).

It is discussed in general the possibility in quantum field theories of quantum tunneling decays of classically stable, localized, non-trivial field configurations. Such tunneling events would correspond to the decay of metastable particles in the field theory. We illustrate this phenomenon by constructing a model, based on a simple one-space, one-time dimensional field theory, in which such particle tunneling decays can actually occur. Using collective coordinate techniques similar to those applied to calculations of nuclear fission, we study the tunneling decay and estimate the lifetimes of the metastable particles. We comment briefly on the role of higher quantum corrections to tunneling and on possible additional examples of these particle tunneling decays.

6455 Scattering Theory

REFER ALSO TO CITATION(S) 17758

17680 **Solution of the unitarity equation with overlapping left and right cuts: a tool for study of the S* and similar systems.** Johnson, P.W.; Warnock, R.L. (Illinois Institute of Technology, Chicago). *Journal of Mathematical Physics (New York)* ; **22**: No. 2, 385-399(Feb 1981).

The partial-wave unitarity condition is complicated by the presence of overlapping left and right branch cuts when the lowest exchanged mass is small in comparison to the direct-channel mass. A coupled-channel ND^{-1} method for constructing unitary amplitudes with overlapping cuts is described. The study is motivated in part by the problem of analyzing the $\pi\pi$-KK-bar system near the S* resonance.

65 PHYSICS RESEARCH

6510 Nuclear Physics

17681 **(DOE/NDC—21/L(Vol.1)) Symposium on neutron cross-sections from 10 to 50 MeV.** Bhat, M.R.; Pearlstein, S. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH0016. 431p. (BNL-NCS—51245(Vol.1); NEANDC(US)—208/L(Vol.1); INDC(USA)—84/L(Vol.1); CONF-800551—(Vol.1)). NTIS, PC A19/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Separate abstracts were prepared for 22 of the papers in this volume. The remaining six have already been cited in ERA, and can be located by reference to the entry CONF-800551—(Vol.1) in the Report Number Index. CINDA and charged-particle reaction indexes for both volumes of this report appear at the end of volume II. (RWR)

17682 **(DOE/NDC—21/L(Vol.1), pp 19-29) Differential data including dosimetry reactions.** Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The status of differential data measurements for neutron reactions is assessed. Although progress has been made in some areas since 1977, most of the recommendations made then for work in this field are still valid. (RWR)

17683 **(DOE/NDC—21/L(Vol.1), pp 31-41) FMIT related problems: shielding and materials damage studies.** Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Several areas affecting both FMIT design and utilization that are dependent on adequate nuclear data are pointed out. The status of nuclear data for FMIT applications is briefly described. Recommendations are made for actions that are considered vital for the successful utilization of the FMIT facility in the areas of dosimetry, damage cross sections, shielding, and sensitivity studies. Although much progress has been made in the last three years, much more is required. Increased interaction between users and generators of nuclear data will expedite this progress. Measured and calculated cross section sets must be put into usable form in order to have impact on FMIT utilization. 1 table. (RWR)

17684 **(DOE/NDC—21/L(Vol.1), pp 61-71) 10 to 50 MeV neutron cross sections: an overview of accomplishments in the context of the 1977 Symposium.** Smith, A.B. (Argonne National Lab., IL). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Some reflections on the status of 10- to 50-MeV neutron cross sections are given as viewed from an outside perspective. The foundation is the Symposium of 1977 with its conclusions and recommendations. Responsiveness to those recommendations and accomplishments during the intervening three years are assessed. 51 references.

17685 **(DOE/NDC—21/L(Vol.2)) Symposium on neutron cross-sections from 10 to 50 MeV.** Bhat, M.R.; Pearlstein, S. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. 451p. (BNL-NCS—51245(Vol.2); NEANDC(US)—208/L(Vol.2); INDC(USA)—84/L(Vol.2); CONF-800551—(Vol.2)). NTIS, PC A20/MF A01.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Separate abstracts were prepared for four of the papers in this volume. The remaining fifteen have already been cited in ERA, and can be located by reference to the entry CONF-800551—(Vol.2) in the Report Number Index. CINDA and charged-particle reaction indexes are included. (RWR)

17686 **(ORNL/TM—7786) Report to the DOE Nuclear Data Committee.** Lundy, J.C.; Perey, F.G. (comps.). (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

This report was prepared for the DOE Nuclear Data Committee, and covers work performed at ORNL since April 1980 in areas of nuclear data of relevance to the US applied nuclear energy program. The report was mostly generated through a review of abstracts of work completed to the point of being subjected to some form of publication in the open literature, formal ORNL reports, ORNL technical memoranda, progress reports, or presentation at technical conferences. As much as possible the complete abstract of the original publication has been reproduced with only minor editing. In a few cases progress reports were written specifically for this publication. The editors have selected the material to be included in this report on the basis of perceived interests of DOE Nuclear Data Committee members.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 17275

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 17693

17687 **Deuteron D-wave and the non-eikonal effects in tensor asymmetries in elastic proton-deuteron scattering.** Alberi, G. (Trieste Univ. (Italy). Istituto di Fisica Teorica); Bleszynski, M. (Los Alamos Scientific Lab., NM (USA); California Univ., Los Angeles (USA). Dept. of Physics); Jaroszewicz, T. (International Centre for Theoretical Physics, Trieste (Italy)); Santos, S. (Rio de Janeiro Univ. (Brazil). Instituto de Fisica). *Physics Letters, [Section] B ;* **92**: No. 1/2, 41-45(May 1980).

It is shown that the tensor asymmetries in the elastic proton-deuteron scattering at medium energies are very sensitive to the non-eikonal corrections to the Glauber model. This sensitivity originates from the fact that, in double scattering, the non-eikonal corrections affect in a different way the contributions coming from the S- and D-wave parts of the deuteron wave function. This leads to considerable change of the tensor asymmetries not only in the region of the interference between single and double scatterings, but also in the region of dominance of the double scattering. It is suggested that these effects should be taken into account in any careful analysis of the proton-deuteron polarization data, which has as a goal the extraction of the NN amplitudes.

17688 **Observation of d-^{3}He fusion reactions in a tokamak plasma.** Chrien, R.E.; Colestock, P.L.; Eubank, H.P.; Hosea, J.C.; Hwang, D.Q.; Strachan, J.D.; Thompson, H.R. Jr. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CHO-3073. *Physical Review Letters ;* **46**: No. 8, 535-538(23 Feb 1981).

d-^{3}He reactions have been observed in the Princeton Large Torus by detecting the unconfined 14.7-MeV proton. Reaction rates as high as 2 x 10^{13} sec^{-1} resulting in 60 W of fusion power were obtained by 500-kW heating of a ^{3}He minority in the ion-cyclotron range of frequencies to energies above 80 keV. The fusion-power multiplication of about 10^{-4} is equal to the highest obtained in any controlled-fusion experiment.

17689 **Spin rotation and depolarization in the ^{2}H(p vector,p vector)^{2}H reaction and the double-spin-flip part of the NN amplitude.** Bleszynski, M. (Los Alamos Scientific Lab., NM (USA); California Univ., Los Angeles (USA)). *Physics Letters, [Section] B ;* **92**: No. 1/2, 91-94(May 1980).

It is shown that a specific set of measurements involving elastic scattering of polarized protons from an unpolarized deuterium target should furnish very useful, selective information on the p-d elastic collision matrix. The possibility of isolation of two observables which depend strongly on the double-spin-flip N-N amplitudes is discussed. The experimental study of the energy dependence of these observables could yield valuable information on the resonant behaviour of the p-p and p-n amplitudes.

6513 Nuclear Properties And Reactions, A=6-19

REFER ALSO TO CITATION(S) 17702, 17703

17690 (DOE/NDC—21/L(Vol.1), pp 113-132) **Characterization of the Be(d,n) neutron field by passive dosimetry techniques.** Kneff, D.W. (Rockwell International, Canoga Park, CA); Farrar, H. IV; Greenwood, L.R.; Guinan, M.W. Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Neutrons from the Be(d,n) reaction are presently being used for fusion reactor materials testing, because of their relatively high available flux, and because of the close similarity of the neutron spectrum to that of the Fusion Materials Irradiation Test Facility (FMIT), now being constructed. However, both irradiation environments have (or will have) steep fluence and energy spectrum gradients in the high-flux regions of their irradiation volumes. Characterization of these neutron environments is thus necessary for the full understanding of any irradiation experiments. A characterization of the Be(d,n) neutron field for 30-MeV deuterons, using foil activation and helium accumulation neutron dosimetry is described. The results show the steep fluence and spectrum gradients, and demonstrate the importance of including comprehensive passive dosimetry in all Be(d,n) and Li(d,n) irradiations where a knowledge of fluence information is required. Relative helium generation cross sections are presented for the helium accumulation dosimetry materials, and some comparisons are made with ENDF/B-IV helium production cross sections. 12 figures, 3 tables.

17691 (DOE/NDC—21/L(Vol.1), pp 147-154) **Low energy neutron emission from Be(d,n) and Be(p,n) reactions.** Lone, M.A. (Atomic Energy of Canada Ltd., Chalk River, Ontario); Robertson, B.C. Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Neutron sources based on Be+d reactions at E/sub d/ $\geqq$ 16 MeV and Be+p reactions at E/sub p/ $\geqq$ 30 MeV are commonly used for cancer therapy. The neutron spectral distributions from these reactions show significant yield at neutron energies below 2 MeV. The relative proportion of these low-energy neutrons at E = 10, 15, 20, and 25 MeV is 33, 28, 21, and 15% for deuterons and 70, 62, 52, and 40% for protons, respectively. Several nuclear reaction mechanisms, e.g. compound nucleus decay and multibody breakup, have been discussed as possible sources of the low-energy neutron component. The systematic studies indicate that the neutron decay of states in Be excited by direct inelastic reactions also plays a significant role in producing low-energy neutrons, particularly from the Be+p reaction. 4 figures, 1 table.

17692 (DOE/NDC—21/L(Vol.1), pp 193-199) **Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD.** Lone, M.A.; Santry, D.C.; Inglis, W.M. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Production of fast neutrons from capture of thermal neutrons in ^{6}LiD and LiD is measured and calculated. The thick-target fast-neutron yield measured from a ^{6}LiD converter is 156 x 10^{-6} per thermal neutron of which ~ 67% is from neutrons with E/sub n/ > 12 MeV. The corresponding numbers for LiD are 318 x 10^{-6} and ~ 35%. 2 figures, 1 table.

17693 (DOE/NDC—21/L(Vol.1), pp 259-275) **Neutron physics research at Triangle Universities Nuclear Laboratory.** Walter, R.L. (Duke Univ., Duke Station, NC); Gould, C.R. Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

A review of the neutron physics research related to cross-section determinations or parametrizations is given. Six topics are described: neutron scattering from light nuclei; elastic and discrete inelastic scattering from medium-weight and heavy nuclei; highly inelastic neutron scattering; Lane optical-model analyses of complete data sets; neutron polarization and the spin-orbit term; radiative capture reactions. 13 figures.

17694 (DOE/NDC—21/L(Vol.1), pp 331-341) **Neutron-induced charged particle measurements from carbon, nitrogen, and oxygen at UC, Davis.** Subramanian, T.S.; Romero, J.L.; Brady, F.P. (Univ. of California, Davis). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Continuum differential cross sections for neutron-induced reactions on light elements have been measured at the Crocker Nuclear Laboratory of the University of California at Davis. The neutrons were produced via the ^{7}Li(p,n) reaction, and the beam was collimated at 0° to deliver a flux of ~ 10^5/cm^2-s at the experimental area. Charged particles ranging from protons through alphas were detected with three-element charged-particle-detection telescopes. The measurements were made at incident neutron energies of 27.4 MeV, and 60.7 MeV and for wide angular range covering 15° through 150°. Some of these continuum cross sections obtained

for carbon, oxygen, and nitrogen are presented. Where possible, comparisons are made for both differential and angle-integrated cross sections with corresponding charge-symmetric reaction cross sections from data published from ORNL with protons as projectiles. Model predictions are also presented for comparison with angle-integrated spectra. 7 figures.

17695 (DOE/NDC—21/L(Vol.1), pp 375-388) **Differential scattering cross section measurements above 20 MeV.** Finlay, R.W.; Rapaport, J. (Ohio Univ., Athens). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The status of differential elastic and inelastic neutron scattering data is reviewed in the energy region above 20 MeV from the time of the May 1977 Brookhaven Conference to the present. Substantial progress has been made in this area, and new information about the optical-model description of the nucleon-nucleus interaction has been obtained. Quantitative information about isovector effects in the optical model and in nuclear transition amplitudes is beginning to emerge. Technical limitations in the areas of source intensity, resolution, and sample quality have restricted the domain of the measurements to nuclei with widely separated excitated states and large natural abundances. Although several of these easily measured cases remain to be studied, many of the nuclei that are most important to the fusion energy program remain inaccessible to present-day techniques. 5 figures, 2 tables.

17696 (DOE/NDC—21/L(Vol.1), pp 413-420) **Cross sections for the reactions of ^{9}Be(n,t$_1\gamma$) and ^{12}C(n,n'γ) between 13.0 and 15.0 MeV.** Hino, Y.; Itagaki, S.; Sugiyama, K. (Tohoku, Univ., Sendai, Japan). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The neutron-induced cross sections of γ rays have been measured for 0.478 MeV from beryllium and 4.43 MeV from carbon in the region energies 13.0 to 15.0 MeV. The γ rays are observed with a Ge(Li) detector placed at an angle of 90^0. In order to produce neutrons, the T + d reaction has been used. The 0.478-MeV γ rays from beryllium follow the emission of triton leading to the first excited state of ^{7}Li. It is concluded that the cross section of ^{9}Be(n,t$_1\gamma$) reaction shows a flat behavior over the neutron energies rather than the large resonance near 13 MeV. The result for the 4.43-MeV γ ray from carbon is in good agreement with previous data. 5 figures, 1 table.

17697 (INKA-Conf—79-001-000, pp 119-123) **Giant resonance studies with high energy heavy ions.** Doll, P.; Hendrie, D.L.; Mahoney, J.; Menchoca-Rocha, A.; Scott, D.K.; Symons, T.J.M.; Van Bibber, K.; Viyogi, Y.P.; Wiemann, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1979.

From International workshop on gross properties of nuclei and nuclear excitations VII; Hirschegg, Kleinwalsertal, Austria (15 Jan 1979).

The authors present evidence for the excitation of giant multipole resonances in inelastic scattering of 315 MeV ^{16}O ions on ^{12}C, ^{58}Ni and ^{208}Pb targets.

17698 **Electromagnetic transitions in ^{14}C and ^{14}N.** Kozub, R.L.; Lin, J.; Mateja, J.F.; Lister, C.J.; Millener, D.J.; Warburton, E.K. (Department of Physics, Tennessee Technological University, Cookeville, Tennessee 38501). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1571-1580(Apr 1981).

The lifetimes of the J/sup π/=0$^+$ 6590-keV and J/sup π/=3$^-$ 6728-keV states in ^{14}C and the J/sup π/=3$^-$ 5834-keV state in ^{14}N were measured using the recoil distance method. Gamma rays following the pn and 2n evaporation channels from ^{9}Be+^{7}Li reactions were detected at θ/sub γ/=0^0. The experimental results are ^{14}C(6590,0$^+$), tau=3.7 +- 0.9 ps; ^{14}C(6728,3$^-$), tau=96 +- 15 ps; ^{14}N(5834,3$^-$), tau=12.9 +- 1.9 ps. Extensive shell-model calculations for both ^{14}C and ^{14}N have been performed using an SU(3) basis and are compared to these and other experimental results.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 17704, 17707, 17713

17699 **(DOE/ER/10418—T1) Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981.** Petitt, G.A. (Georgia Univ., Athens (USA). Dept. of Physics). 1981. Contract AS05-80ER10418. 13p. NTIS, PC A02/MF A01.

A summary of research activities studying heavy-ion reactions is presented. Reactions studied include ^{16}O + ^{93}Nb at 208 MeV; and ^{12}C + ^{158}Gd and ^{13}C + ^{157}Gd at 100- to 200-MeV. (GHT)

17700 (DOE/NDC—21/L(Vol.1), pp 421-427) **Scattering of 10 MeV neutrons by silicon.** Pilz, W.; Schmidt, D.; Seeliger, D.; Streil, T. (Technische Universitat Dresden, Germany). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Anuglar distributions for several neutron groups of the ^{28}Si(n,n') reaction are measured at 10 MeV bombarding energy. The experimental data are analyzed by a combined statistical and direct reaction model. The theoretical description gives information about excitation modes and strengths. 2 figures, 2 tables.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 17693, 17697, 17707, 17709, 17712, 17713, 17718

17701 **(DOE/ER/10405—2) Nuclear structure approach to the calculation of the imaginary alpha-nucleus optical potential.** Dermawan, H.; Osterfeld, F.; Madsen, V.A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Oregon State Univ., Corvallis (USA). Dept. of Physics). 1981. Contract AT06-79ER10405. 29p. NTIS, PC A03/MF A01.

A microscopic calculation of the second-order imaginary optical potential for ^{40}(Ca(α,α) is made for incident energies of 31 and 100 MeV using RPA transition densities for intermediate excited states. The projectile is treated as an elementary particle, and the alpha-nucleon interaction is normalized by fitting 3$^-$ inelastic cross sections with a folded M3Y potential. The use of an optical Green's function for the intermediate propagator is found to be important. Equivalent local potentials are obtained and used to calculate elastic scattering cross sections. Agreement with low-angle experimental data is fair at 31 MeV, but at 100 MeV the calculated cross sections indicate much too little absorption. 9 figures, 1 table.

17702 (DOE/NDC—21/L(Vol.1), pp 313-330) **Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis.** Zanelli, C.I. (Univ. of California, Davis); Brady, F.P.; Romero, C.M.; Castaneda, C.M.; Johnson, M.L.; Needham, G.A.; Ullmann, J.L.; Urone, P.P.; Johnson, D.L. Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Neutron total cross sections for Ca and Fe at 35.3, 40.3, and 50.4, and for C at 50.4 MeV have been measured using nearly mono-energetic neutron beams. The overall total cross section uncertainties are <3%. Total nonelastic cross sections for C, O, Ca, and Fe were measured for incident neutrons of 40.3 and 50.4 MeV by means of a transmission technique with a nearly mono-energetic beam. The overall uncertainties average about 8% for the nonelastic cross sections. 5 figures, 2 tables.

17703 (DOE/NDC—21/L(Vol.1), pp 389-397) **Neutron induced charged particle reaction studies at Ohio University.** Randers-Pehrson, G.; Finlay, R.W.; Grabmayr, P.; Kulkarni, V.; Lane, R.O.; Rapaport, J. (Ohio Univ., Athens). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The Triplet Quadrupole Spectrometer now in use at Ohio University is described; those features that distinguish it from the

similar device at Lawrence Livermore Laboratory are particularly emphasized. In addition, the (n, charged particle) reactions presently under investigation are reviewed. 4 figures.

17704 (DOE/NDC—21/L(Vol.2), pp 539-552) **Integral cross section measurements on (n,x) reactions induced by 30 MeV d(Be) break-up neutrons on FRT wall and structural materials.** Qaim, S.M.; Khatun, S.; Woelfle, R. (Inst. fuer Chemie 1, Kernforschungsanlage, Julich, Germany). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Integral cross sections were measured by the activation technique for some 30-MeV d+Be breakup-neutron-induced (n,2n), (n,3n), (n,p), [(n,n'p) + (n,d)], (n,α), (n,n'α), and (n,^{3}He) reactions on isotopes of the elements Al, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Nb, and Mo. Tritium formation cross sections were determined for the elements Al, Cr, Mn, Fe, Co, Ni, and SS by vacuum extraction and gas counting of tritium. The integral cross section data agree within 20% with the average cross section values deduced from the known excitation functions of a few reactions. Some preliminary systematic trends observed in the cross section data are described. A comparison of the 30-MeV d+Be neutron cross sections with those available at 14.5 MeV is given, and some of the possible consequences of the use of a 30-MeV d+Be neutron source for radiation damage studies, instead of a 14-MeV d+T source, especially with regard to hydrogen and helium gas production in wall and structural materials, are discussed. 3 figures, 3 tables.

17705 **Nuclear structure of high-spin states in ^{46}Ti and ^{46}V.** Poletti, A.R.; Warburton, E.K.; Olness, J.W. (Department of Physics, University of Auckland, Auckland, New Zealand). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1550-1559(Apr 1981).

The nuclear structure of high-spin states in ^{46}Ti and ^{46}V has been investigated using the ^{40}Ca(^{9}Be, 2pn)^{46}Ti and ^{40}Ca(^{9}Be, p2n)^{46}V reactions. Excitation function, angular distribution, recoil distance, Doppler shift attentuation, and γ-γ coincidence measurements were undertaken. Some additional data on ^{46}Ti from the ^{35}Cl(^{16}O,αp)^{46}Ti reaction are included.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 17693, 17695, 17704, 17712, 17713, 17718

17706 **Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr.** DiGiacomo, N.J. Boulder, CO; Univ. of Colorado (1979). 253p. University Microfilms Order No. 80-02,967.

Thesis (Ph. D.).

The optical model and collective model DWBA approach to proton elastic and inelastic scattering was extended to momentum transfer of four inverse fermis. Elastic and inelastic proton scattering data at 0.8 GeV were taken on ^{89}Y and ^{90}Zr with the high-resolution spectrometer at LAMPF. These data were analyzed within the optical model and collective model DWBA, and the results, compared to similar analyses performed at projectile energies of 18 to 180 MeV. Approximations made in the theory to include relativistic effects were tested and found to be reasonable. The energy dependence of the projectile-nucleus empirical optical potential was clarified, and a detailed optical model analysis of the elastic scattering was performed. The elastic and inelastic cross sections were found to be insensitive to the inclusion of spin-orbit effects. The first observation of a giant multipole resonance excited by 0.8-GeV proton inelastic scattering was reported. The low-energy octupole resonance in ^{90}Zr was found to have an isoscalar strength similar to that found by lower-energy alpha inelastic scattering investigations. It is concluded that the optical model and collective model DWBA provide a good description of the data to momentum transfers of four inverse fermis. As far as these reactions are concerned, the 0.8 GeV proton is quite similar to the lower-energy alpha particle. The increase of almost an order of magnitude in projectile energy does not, within this type of analysis, reveal any new nuclear structure information.

17707 (DOE/NDC—21/L(Vol.1), pp 289-300) **Helium generation cross sections for fast neutrons.** Kneff, D.W.; Oliver, B.M.; Nakata, M.M.; Farrar, H. IV. (Rockwell International, Canoga Park, CA). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Fast-neutron-induced total helium production cross sections are an important source of information for the development of materials for fusion reactors. These cross sections are presently being measured at Rockwell International, with the measurements based on high-sensitivity gas mass spectrometry. Cross sections are given for helium production in Al, Ti, Cr, Fe, Ni, Cu, Au, and the separated isotopes of Ni and Cu, for ~ 14.8-MeV neutrons from the T(d,n) reaction. A detailed fluence mapping of the irradiation volume was required to relate helium generation measurements to cross sections. The importance of comprehensive passive dosimetry in all fast-neutron irradiation experiments is emphasized. 4 figures, 1 table.

17708 (INIS-mf—6088, pp 104-108) **Charge and mass exchange in ^{56}Fe-induced reactions.** Mignerey, A.C.; Breuer, H.; Glagola, B.G.; Viola, V.E. (Maryland Univ., College Park (USA)); Wolf, K.L. (Argonne National Lab., IL (USA)); Birkelund, J.R.; Hilscher, D.; Huizenga, J.R.; Schroeder, W.U.; Wilcke, W.W. (Rochester Univ., NY (USA)). Feb 1980.

From Workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1980).

Yields of projectile-like fragments have been measured with discrete A and Z resolution as a function of total kinetic energy loss (E/sub LOSS/) for symmetric and asymmetric systems with varying A/Z ratios. Monoisotopic targets of ^{56}Fe, ^{165}Ho and ^{209}Bi were bombarded with 465 MeV ^{56}Fe ions from the Lawrence Berkeley Laboratory Super-HILAC accelerator. Inclusive charge and mass distributions show that, for the asymmetric systems, a drift in the Z-bar toward smaller atomic numbers can be attributed to a charge equilibration process in which protons are preferentially transferred from the Fe-like fragments to the heavy partner. The dependence of A-bar/Z-bar on E/sub LOSS/ shows a smooth increase which saturates in the range E/sub LOSS/ approx. 100-150 MeV at a value of A-bar/Z-bar approx. 2.3 for the asymmetric system. Although smaller than the A/Z of the combined systems, the values attained are close to the equilibrium values derived from shell-corrected liquid drop potential energy surfaces.

17709 **Recent experiments at the GSI on-line separator.** Roeckl, E. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). pp 397-404 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

A review is given on recent experiments at the GSI on-line separator. Heavy-ion induced fusion reactions and the structure of nuclides far from beta stability are studied in the regions of tin and lead isotopes. The status of the various investigations is described together with possible extensions and improvements.

17710 **Test of vacuum polarization by precise investigation of Delbrueck scattering.** Rullhusen, P.; Mueckenheim, W.; Smend, F.; Schumacher, M.; Berg, G.P.A.; Mork, K.; Kissel, L. (II. Physikalisches Institut, University of Goettingen, D-3400 Goettingen, Germany). W-7405-ENG-48. *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1375-1383(Apr 1981).

Using sources of ^{24}Na, differential cross sections for elastic scattering of 2.754 MeV photons have been measured for angles between 60 and 120° and charge numbers of 30, 42, 50, and 58 with an accuracy of 2.8% on the average. For the cases covered by experiment, Delbrueck scattering amplitudes have been calculated on the basis of the lowest-order Feynman graphs with an average numerical accuracy of 1%. For the same cases Rayleigh scattering amplitudes have been calculated on the basis of the second-order S matrix using Dirac-Hartree-Fock-Slater wave functions. These investigations confirm the lowest-order Delbrueck theory with an ac-

curacy of 5%. This corresponds to a new test of vacuum polarization of the order $\alpha(Z\alpha)^2$.

17711 **Fast-particle emission in the deep-inelastic reaction Cu+20Ne at 12.6 MeV/nucleon.** Schmitt, R.P.; Wozniak, G.J.; Rattazzi, G.U.; Mathews, G.J.; Regimbart, R.; Moretto, L.G. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters ;* **46**: No. 8, 522-525(23 Feb 1981).

Fast protons (1—2.4 times the beam velocity) have been studied. The spectral shapes in both singles and coincidence spectra are similar. The most energetic protons are associated with intermediate-velocity products rather than beam-velocity ones. The observed high energies and the forward-peaked angular distributions could be explained by evaporation calculations which included thermal fluctuations in the division of the excitation energy between the two fragments of the intermediate complex.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 17699, 17704, 17706, 17706, 17709, 17710, 17718, 17720, 17724, 17727

17712 (DOE/NDC—21/L(Vol.1), pp 342-374) **Measurement of the angle-integrated secondary neutron spectra from interaction of 14 MeV neutrons with medium and heavy nuclei.** Vonach, H.; Chalupka, A.; Wenninger, F.; Staffel, G. (Inst. fuer Radiumforschung und Kernphysik der Oesterr, Wien, Austria.). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The angle-integrated secondary neutron spectra from interactions of 14.1-MeV neutrons with 17 elements in the range Ti to Bi were measured over the secondary neutron energy range 0.25 to 6 MeV with special emphasis on obtaining reliable and accurate neutron production cross-sections in the low energy region (0.25 to 1 MeV). An overall accuracy of 5 to 7% was obtained over most of the investigated energy ranges. The results are in good agreement with the predictions of statistical model calculations and, in the neutron energy range above 1.5 MeV, also with most other recent measurements; in the low energy range there are still large discrepancies between the results of different measurements. 14 figures, 1 table.

17713 (DOE/NDC—21/L(Vol.2), pp 711-729) **Comparison of experimental and calculated neutron emission spectra and angular distributions.** Gruppelaar, H.; Akkermans, J.M. (Netherlands Energy Research Foundation, Petten). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Experimental and calculated neutron emission spectra and angular distributions have been intercompared for 14.6-MeV neutron-induced reactions. The experimental data, measured by Hermsdorf et al. [Zfk-277], cover 34 elements in a large mass range. To calculate the differential neutron scattering cross sections a unified model of preequilibrium neutron emission was used, in which the generalized master equation of Mantzouranis et al. [Phys. Lett., 57B, 220 (1975)] was solved with a fast exact matrix method, recently introduced by Akkermans [Phys. Lett., 82B, 20 (1979)]. For the scattering kernel a three-term Legendre polynomial representation was adopted, which was either derived from the differential free nucleon-nucleon scattering cross section or fitted to obtain optimal agreement with the set of experimental data of Hermsdorf et al. The results of the last-mentioned calculation are quite acceptable in view of the fact that only two global parameters were used to describe the angular distributions of all experimental data. It is further shown that improvements in the energy and angular distributions could be obtained by means of adjustment of the level-density parameters of the individual residual nuclei. Finally, a short discussion is devoted to the problems of fitting angular distributions at backward angles by varying the model parameters or the specification of the initial condition. 5 figures, 4 tables.

17714 **Particle properties of collective states.** Peker, L.K.; Hamilton, J.H. (Brookhaven National Lab., Upton, NY (USA)). pp 323-335 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

An analysis is made of the available data on possible two-phonon vibrational states in light of the expectations of a pure phonon collective model. Also the microscopic structure of 2^+ γ-vibrational states and the E1 branchings to 0^+ and 2^+ states from octupole states were analyzed. All these data show strong deviations from the properties expected in a pure collective picture. These deviations suggest that the particle properties of these states are important features that must be considered in any detailed analysis.

17715 **Decay of ^{90}Rb/sup g/ and ^{90}Rb/sup m/.** Talbert, W.L. Jr.; Wohn, F.K.; Alquist, L.J.; Duke, C.L. (Ames Laboratory—Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1726-1738(Apr 1981).

The β and subsequent γ decays of ^{90}Rb/sup g/ and ^{90}Rb/sup m/ have been studied using an on-line isotope separator system. Ge(Li) γ-ray singles and γ-γ coincidence measurements were used to construct level schemes for ^{90}Sr. The decays of the two ^{90}Rb activities were distinguished using a set of four experiments in which the collection and observation parameters were adjusted to change the relative decay intensities. For the decay of ^{90}Rb/sup g/, 83 attributed γ-ray transitions were placed among 33 excited states of ^{90}Sr, whereas for the decay of ^{90}Rb/sup m/, 43 excited states of ^{90}Sr provided placement for 108 attributed γ rays. Twelve γ rays were not placed in either level scheme, and 42 transitions are common to both decays. Spin and parity assignments have been deduced using β-decay logft values, γ-γ angular correlation data, and reaction data in the literature. Interpretation of some of the energy levels is made from a shell-model viewpoint.

17716 **Atomic masses for nuclides far from stability.** Wapstra, A.H. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). pp 209-219 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

New alpha decay energies have been measured for very neutron-deficient nuclides with A = 105 - 115 and 145 - 170. Some of these alpha chains are connected to the system of known masses by new reaction energies. An important set of new beta decay energies has become available for neutron-rich nuclides with A = 90 - 100 and 140 - 150. These and other data are compared with one another and especially with the very important new on-line mass determinations for Rb and Cs isotopes far from stability.

17717 **Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region.** Lane, S.M. Davis, CA; Univ. of California (1979). 262p. University Microfilms Order No. 80-03,519.

Thesis (Ph. D.).

An experimental investigation of the level structure of $_{52}{}^{133}Te_{81}$ has been performed by spectroscopy of gamma rays following the beta decay of 2.7-min ^{133}Sb. Antimony isotopes were separated from gross fission products by antimony hydride production. Multiscaled gamma-ray singles spectra and 2.5 x 10^7 gamma-gamma coincidence events were used in the assignment of 105 of the approximately 400 observed gamma rays to ^{133}Sb decay and in the construction of the ^{133}Te level scheme with 29 excited levels. One hundred twnety-two gamma-rays were identified as originating in the decay of other isotopes of Sb or their daughter products. A new computer program based on the Lanczos tridiagonalization algorithm using an uncoupled m-scheme basis and vector manipulations was used to calculate energy levels, parities, spins, model wave functions, neutron and proton separation energies, and some

electromagnetic transition probabilities for the following nuclei in the $^{132}Sn_{82}$ region: ^{128}Sn, ^{129}Sn, ^{130}Sn, ^{131}Sn, ^{130}Sb, ^{131}Sb, ^{132}Sb, ^{133}Sb, ^{132}Te, ^{133}Te, ^{134}Te, ^{134}I, ^{135}I, ^{135}Xe, and ^{136}Xe. The results are compared with experiment and the agreement is generally good. For nonmagic nuclei the $1g_{7/2}$, $2d_{5/2}$, $2d_{3/2}$, $1h_{11/2}$, and $3s_{1/2}$ orbitals are available to valence protons and the $2d_{5/2}$, $2d_{3/2}$, $1h_{11/2}$ and $3s_{1/2}$ orbitals are available to valence neutron holes. The present computer code can accommodate 59 single-particle states and vectors comprised of 30,000 Slater determinants. The effective interaction used was that of Petrovich, McManus, and Madsen. Single-particle energies, effective charges, and effectve g factors were determined from experimental data for nuclei in the ^{132}Sn region.

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 17699, 17708, 17712, 17716, 17724

17718 (DOE/NDC—21/L(Vol.1), pp 399-411) **Status of (n,2n) cross section measurements at Bruyeres-le-Chatel.** Frehaut, J.; Bertin, A.; Bois, R.; Jary, J. (Service de Physique Neutronique et Nucleaire, Centre d'Etudes de Bruyeres-le-Chatel, France). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Cross sections for the (n,2n) reactions have been measured between threshold and 15 MeV for about 50 elements and separated isotopes by using the large gadolinium-loaded liquid scintillator method and the 7 MV tandem Van de Graaff accelerator of Bruyeres-le-Chatel as a pulsed neutron source. The (n,2n) cross sections have been normalized to the fission cross section of ^{238}U; they are obtained with a relative accuracy of 4% to 10%. The systematic trends of the data obtained on series of separated isotopes are discussed, and some comparisons with statistical model calculations are presented. 2 figures, 11 tables.

17719 (INKA-Conf—79-001-000, pp 94-97) **Neutron emission from the strongly damped reaction $^{165}Ho + ^{56}Fe$ at 8.5 MeV.** Hilscher, D.; Wilcke, W.W.; Schroeder, W.U.; Hoover, A.D.; Birkelund, J.R.; Huizenga, J.R. (Rochester Univ., NY (USA). Nuclear Structure Research Lab.); Mignery, A.; Wolf, K.L. (Argonne National Lab., IL (USA)); Breuer, H.; Viola, V.E. Jr. (Maryland Univ., College Park (USA)). Feb 1979.

From International workshop on gross properties of nuclei and nuclear excitations VII; Hirschegg, Kleinwalsertal, Austria (15 Jan 1979).

Neutron and α-particle emission from the $^{165}Ho + ^{56}Fe$ reaction at 8.5 MeV/A has been studied for damped and fusion-fission events. It is shown, that the measured multiplicities, energy spectra and angular distributions of neutrons are consistent with a full equilibration of the excitation energy and the N/Z degree of freedom during the reaction time.

17720 **Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta.** Volkov, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). pp 221-230 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Some experimental data are considered, which indicate the validity of the Q/sub gg/ systematics of cross sections for production of isotopes in multinucleon transfer reactions for any target-projectile combination. The effect of the nuclear structure of the light fragment on the evolution and decay of the double nuclear system formed in deep inelastic collisions of complex nuclei is discussed. Predominance of the α-particle emission over all the remaining channels of the disintegration of the double nuclear system is demonstrated. It is shown that deep inelastic transfer reactions can be used to study the deformation of nuclei with large angular momenta.

17721 **Neutron-capture cross sections for osmium isotopes and the age of the universe.** Browne, J.C.; Berman, B.L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1434-1445(Apr 1981).

The neutron-capture cross sections for /sup 186,187,188,189,190,192/Os have been measured by the neutron-time-of-flight technique from 0.5 eV to 150 keV. Nuclear level spacings were extracted from the low-energy (resonance-region) data below ~1 keV, and average cross sections from the data above 1 keV. The ratio of the Maxwellian-weighted average cross sections for ^{186}Os and ^{187}Os near 30 keV is a vital parameter for the determination of the duration of nucleosynthesis prior to the formation of the solar system, and thus for the determination of the age of the universe by the nuclear-dating technique. The present result of 10.8/sup +1.4//sub -2.2/ x 10^9 yr for the duration of nucleosynthesis is in concordance with the value obtained from U-Th dating. The result for the age of the universe (17 +- 3 x 10^9 yr) agrees with the value obtained from the globular-cluster method, but clearly exceeds the most recent determination of the Hubble time.

6519 Nuclear Properties And Reactions, A=190-219

REFER ALSO TO CITATION(S) 17697, 17707, 17708, 17712, 17713, 17718, 17721, 17732

17722 **(DOE/ER/04936—6) Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981.** Bingham, C.R.; Riedinger, L.L.; Guidry, M.W. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1 Mar 1981. Contract AS05-76ER04936. 48p. NTIS, PC A03/MF A01.

Research in nuclear spectroscopy at University of Tennessee from June 1980 through May 1981 is summarized. Topics covered include: radioactive decay studies; high spin states; inelastic scattering and reactions of heavy ions from deformed nuclei; and nuclear structure theory. (GHT)

17723 **(DOE/ER/10434—2) High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report.** Avignone, F.T. III. (South Carolina Univ., Columbia (USA). Dept. of Physics and Astronomy). 28 Feb 1981. Contract AS09-79ER10434. 63p. NTIS, PC A04/MF A01.

Extensive data analysis and theoretical analysis has been done to complete the extensive decay scheme investigation of ^{206} $^{205}F_r$ and the level structures of ^{206} ^{205}Rn. A final version of a journal article is presented in preprint form. Extensive Monte Carlo calculations have been made to correct the end point energies of positron spectra taken with intrinsic Ge detectors for annihilation radiation interferences. These calculations were tested using the decay of ^{82}Sr which has previously measured positron branches. This technique was applied to the positron spectra collected at the on-line UNISOR isotope separator. The reactions used were $^{60}Ni(^{20}Ne;p2n)^{77}Rb$ and $^{60}Ni(^{20}Ne;pn)^{78}Rb$. Values for 5, γ-β^+ coincidence positron end point energies are given for the decay of ^{77}Rb. The implied Q-value is 5.075 +- 0.010 MeV. A complete paper on the calculated corrections is presented. A flow chart of a more complete program which accounts for positrons scattering out of the detector and for bremsstralung radiation is also presented. End-point energies of four β^+ branches in ^{77}Rb are given as well as a proposed energy level scheme of ^{75}Kr based on γ-γ coincidence data taken at UNISOR.

17724 **(DOE/ER/13246—20) Nuclear research with heavy ions. Annual progress report, January 1, 1980-December 31, 1980.** Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry). Oct 1980. Contract AS02-76ER13246. 95p. (COO—3246-20). NTIS, PC A05/MF A01.

The program of research is oriented towards experimental studies of the interactions between heavy ions and complex nuclei. These interactions are probed by detailed measurements of light-charged-particle emission using counter telescopes for atomic

number and mass number identification. Singles measurements of the charged-particle energy spectra and angular distributions, together with coincidence correlations with heavy nuclear-reaction fragments, provide insight into the contributing reaction mechanisms. The application of the statistical model to the appropriate experimental data allows the determination of parameters necessary to calibrate the theory, and gives indications of dynamical control vs. equilibrium in the several degrees of freedom associated with the nuclear collisions. A large body of data are presented and discussed for ^{40}Ar reactions with ^{116}Sn, ^{154}Sm, ^{164}Dy, and ^{197}Au targets. Complete results are also given for twelve reactions which produce ^{194}Hg compound nuclei at several excitation energies.

17725 (DOE/NDC—21/L(Vol.1), pp 201-212) **Neutron yields and spectra from 590 MeV (p,n) reactions on lead targets.** Cierjacks, S.; Rainbow, M.T.; Swinhoe, M.T.; Buth, L. (Kernforschungszentrum Karlsruhe, Germany). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Time-of-flight measurments of neutrons and protons produced by bombardment of thick lead targets with 590-MeV protons have been carried out at the SIN cyclotron. Measurements were made at angles of 30°, 90°, and 150° for different penetration depths of protons in a 10 cm diam x 60 cm long target. The detector was an NE213 liquid scintillator. Differential neutron data are presented and compared with intranuclear-cascade-evaporation model calculations. First results of the secondary proton yield and spectra are also presented. 7 figures.

17726 (DOE/NDC—21/L(Vol.2), pp 799-813) **Measured and evaluated bismuth cross sections for fusion-fission hybrid reactors.** Smith, A. (Argonne National Lab., IL); Guenther, P.T.; Smith, D.L.; Howerton, R.J. Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

A comprehensive evaluated nuclear data file for elemental bismuth is presented in the ENDF format. This file is particularly tailored to the needs of the fusion-fission hybrid designer. The file is based upon the present measurements and model, together with those previously reported in the literature. The measured neutron total cross sections extended from 1.2 to 4.5 MeV with accuracies of $\approx$ 1%. Neutron-differential elastic-scattering cross sections are measured from 1.5 to 4.0 MeV at energy intervals of $\leqq$ 0.2 MeV over the angular range 20 to 160°. Concurrently, differential cross sections for the inelastic neutron excitation of states at 895 +- 15, 1606 +- 15, 2762 +- 29, 3022 +- 21, and 3144 +- 15 keV are determined. The experimental results are used to develop an optical-statistical model descriptive of the measured values and forming a foundation for the evaluation. 6 figures, 1 table.

17727 **Study of neutron deficient isotopes of Fr and I by means of He-jet technique.** Xi-jun, S.; Jun-sheng, G.; Zhi-zheng, Z.; Zong-you, P.; Ying-xiang, G. (Institute of Modern Physics, Lanchow, China). pp 109-113 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). Amsterdam, Netherlands; North-Holland (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

For the last few years the He-jet technique has been studied and developed. By means of this technique a number of experiments have been performed on synthesis of neutron deficient isotopes. The measurement of excitation functions for Fr isotopes produced by bombardment of ^{12}C on ^{209}Bi and the production of neutron deficient isotopes ^{118}I, ^{117}I and ^{115}I by ^{12}C on natural silver are presented.

17728 **(PB—80-213002) Investigation of the $^{203\ 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV.** Wohlfarth, H.; Kretz, R.; Backe, H.; Hegewisch, S.; Vonach, H. (Technische Hochschule Darmstadt (Germany, F.R.)). Jun 1980. 43p. NTIS, PC A03/MF A01.

Some 259 gamma-lines have been observed with Ge(Li) detectors from ($^{203\ 205}$)Tl(n,n'gamma) reactions with 2.75 MeV neutrons using (/sup nat/)Tl and enriched (^{203})Tl samples. The different gamma lines could be attributed unambiguously to the (^{203})Tl and (^{205})Tl isotopes. It was possible to assign only 60 and 54 transitions to the known level schemes of (^{203})Tl and (^{205})Tl, respectively. From these facts it can be concluded that the low spin members in ($^{203\ 205}$) Tl between 1.5 and 2.7 MeV are only partially known. The decay of a $5/2^-$ level at 2623.1 keV in (205)Tl was identified and the corresponding transition energies have been measured. With these results isomer shifts of general gamma lines corresponding to the decay of the same $5/2^-$ level in muonic (^{205})Tl were determined.

17729 **Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt.** Cizewski, J.A.; Flynn, E.R.; Brown, R.E.; Hanson, D.L.; Orbesen, S.D.; Sunier, J.W. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1453-1476(Apr 1981).

The /sup 194,196,198/Pt(t,p) reactions have been measured with 17 MeV tritons on enriched and natural Pt targets. The level structure of ^{200}Pt is probed for the first time, and several new excited 0^+ states have been identified in /sup 196,198,200/Pt. Systematics in level structure of /sup 192en-dash200/Pt are fairly constant, although there is evidence that /sup 198,200/Pt are becoming more vibrational in structure, with the γ-unstable shape of the lighter Pt nuclides becoming more oblate-like. Systematics of L=4 strengths are considered and can be qualitatively understood. The (t,p) strengths measured in the present study are combined with earlier Pt(p,t) and Os(t,p) measurements and compared with the systematics of two-neutron transfer strengths predicted by the interacting boson approximation, schematic, boson expansion, and pairing vibration models.

17730 **Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn.** Ritchie, B.G.; Avignone, F.T. III; Carter, H.K.; Mlekodaj, R.L.; Spejewski, E.H. (UNISOR, Oak Ridge Associated Universities, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). DE-AC05-760R00033;DEAS-0970-ER-10434. *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1717-1725(Apr 1981).

The isotopes ^{206}Fr and ^{208}Fr were produced by the reactions Ir(^{20}Ne,xn)/sup 206,208/Fr and mass separated on-line. The electron-capture and positron decays to ^{206}Rn and ^{208}Rn were studied by collecting γ ray and internal conversion electron singles spectra as a function of decay time as well as γ-γ, γ-e$^-$, and γ-x ray coincidence spectra. The energies and many of the spins were determined for 18 excited, even parity states in ^{208}Rn and for 10 excited, even parity states in ^{206}Rn. These nuclei appear to be excellent candidates for interpretation in terms of a weak coupling shell model. The energy levels were also compared to the predictions of the interacting boson approximation model.

6520 Nuclear Properties And Reactions, A=220 And Above

17731 (DOE/NDC—21/L(Vol.1), pp 133-145) **Fission reaction in high energy proton cascade.** Takahashi, H. (Brookhaven National Lab., Upton, NY). Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Fission reactions are incorporated in the intranuclear cascade code NMTC to calculate the neutron yield from the high-energy nucleon-nucleus collision. It is assumed that the fission reaction occurs in competition with the evaporation reaction after the spallation reaction. The branching ratio of fission reaction to neutron evaporation reaction is calculated by using the Vandenbosch and Huizenga formula, and the distribution of fission product nuclei is calculated by using Fong's statistical model. Although the most general distribution for fission product nuclei is a function of their excitation energies, mass numbers, charge numbers, kinetic energies, deformation energies, and spin states, a simplification of the model using the most probable kinetic energies and deformation energy has been implemented for determination of the mass and charge distributions. The mass distributions of the post-evaporated nuclei calculated by Fong's mass formula has peaks that are closer to experimental results than the distribution used in Janecke, Garvey, and Kelson's (JGK) mass formula. The mass distribution calculated by

the mass formula in the NMTC code is very close to the one calculated with the JGK mass formula. In contrast to the flat plateau of mass distribution shown in the experimental results of Stevenson for 300-MeV protons on U^{238} nuclei, the three calculations show the dip between two peaks. The total number of neutrons emitted by fission products that are calculated by Fong, JGK, and NMTC mass formulas are, respectively, 12.25, 12.83, and 12.80. 5 figures.

17732 (DOE/NDC—21/L(Vol.1), pp 155-167) **Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons.** Fraser, J.S. (Atomic Energy of Canada Ltd, Chalk River, Ontario); Garvey, P.M.; Milton, J.C.D.; Kiely, F.M.; Thorson, I.M.; Pate, B.D. Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

Neutron capture rates in a water bath surrounding thick, heavy-element targets bombarded by 480-MeV protons have been measured by foil activation. The proton beams impinged on the central element of hexagonal arrays of cylindrical target elements of metallic Pb, Th, and depleted U and of natural UO_2. The experimental data are presented as a function of effective radius. The effects of indenting the central element and of substituting central elements of Pb in place of Th or depleted U have been studied. The data are compared with the results of intranuclear cascade and neutron transport calculations and with the results of analyses of earlier measurement. 8 figures, 5 tables.

17733 (EPRI-NP—1763) **Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu.** Leonard, B.R. Jr.; Thompson, J.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1981. 79p. NTIS.

The thermal neutron cross sections of the isotopes ^{239}Pu and ^{241}Pu have been evaluated in the thermal neutron energy region below 1.0 eV. The method of evaluation fitted energy-dependent data constrained by a modified Adler-Adler multilevel resonance fission and capture formalism and multilevel Breit-Wigner scattering theory. The energy dependence of the number of neutrons per fission was prescribed in the theory by introducing nu as fitted resonance spin-dependent values. The data were fitted in a resonance parameter fitting code, RPFC, using the method of maximum likelihood. The code fits simultaneously the total and partial energy-dependent cross section data to the theory. The types of data explicitly fitted are total, fission, capture, total scattering, coherent scattering, and absorption cross sections plus the quantities alpha, total nu and eta. Relative energy-dependent data with precision errors are fitted along with absolute values and errors at chosen energies. RPFC also allows energy-scale adjustment and Doppler broadening of selected data sets, and fits correlated data of two isotopes simultaneously. Reference experimental data bases of original data plus condensed and modified data were assembled for the evaluation for each isotope. 19 figures, 9 tables.

17734 (ORNL/TM—7661) **Measurement of neutron-transmission spectra through ^{232}Th from 8 MeV to 4 keV.** Olsen, D.K.; Ingle, R.W. (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 62p. (ENDF—307). NTIS, PC A04/MF A01.

Neutron transmission spectra through room-temperature ^{232}Th samples have been measured by use of the time-of-flight technique, the ORELA pulsed neutron source, and a 1-mm-thick Li-glass detector. The measurement and data reduction are described in detail. The 40-m transmission spectra through eight samples are directly compared from 15 to 4000 eV with resolution-broadened transmission spectra calculated from the ENDF/B-V total cross section. Two sets of 22-m transmission spectra through five samples are combined into one total cross section from 0.008 to 15.0 eV and compared with the ENDF/B-V evaluation. 13 figures, 12 tables.

17735 (ORNL/TM—7732) **Thorium resonance-neutron capture (2.6 to 10 keV).** Macklin, R.L. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

Individual resonance parameters are fitted to thorium neutron capture data up to 10 keV. The ENDF/B-V resonance parameters (given up to 4 keV) do not describe the data well. An average radiation width $\Gamma/\text{sub } \gamma/ = 25.5 +- 1.2$ meV is derived together with fitted strength functions $10^4S_0 = (0.86 +- 0.10)$ eV/sup -1/2/, $10^4S_1 = (1.48 +- 0.07)$ eV/sup -1/2/, $10^4S_2 = (1.12 +- 0.06)$ eV/sup -1/2/, and $10^4\Gamma/\text{sub } \gamma/\text{-bar/D/sub } l = 0/ = 14.7 +- 0.5$. 2 figures, 2 tables.

17736 **Fission yields and lifetimes for muon induced fission in ^{235}U and ^{238}U.** Ahmad, S.; Beer, G.A.; Dixit, M.S.; MacDonald, J.A.; Mason, G.R.; Olin, A.; Pearce, R.M. (Victoria Univ., British Columbia (Canada); TRIUMF, Vancouver, British Columbia (Canada)); Haeusser, O. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.); Kaplan, S.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Physics Letters,* [*Section*] *B ;* **92**: No. 1/2, 83-86(May 1980).

The absolute yields of prompt and delayed fission induced by negative muons stopping in ^{235}U and ^{238}U have been measured. A coincidence with muonic K/sub α X-rays was used to identify the muon stop in the target. The time distribution of fissions following the muon stopping were also obtained.

6530 Nuclear Theory

17737 (DOE/NDC—21/L(Vol.1), pp 43-57) **Nuclear model codes and data evaluation.** Jul 1980.

From Symposium on neutron cross sections from 10 - 50 MeV; Upton, NY, USA (12 May 1980).

The present status of evaluations and nuclear models is described, problem areas in model calculations are outlined, and recommendations and conclusions regarding future work are given. 2 tables. (RWR)

17738 (INIS-mf—6088, pp 55-65) **New self-consistent approach to the calculations of nuclear energy levels and their lifetime.** Levit, S. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Theoretical Physics); Negele, J.W. (Los Alamos Scientific Lab., NM (USA)); Paltiel, Z. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Feb 1980.

From Workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (14 Jan 1980).

Energy levels of an interacting fermions system are obtained by periodic solutions of a set of time-dependent self-consistent equations, which satisfy a quantization condition. By means of the stationary phase approximation (SPA) which is applied to the Green's function of the system, the energy of these solutions is shown to be an approximation to an exact energy level in the lowest SPA order. Corrections are given by the quantum fluctuations around the mean field, and by the contribution of complex time solutions. The latter might contribute an imaginary term leading to a finite width and the lifetime of the unstable levels.

17739 **Dipole radiative strength functions from resonance neutron capture.** McCullagh, C.M.; Stelts, M.L.; Chrien, R.E. (Brookhaven National Laboratory, Physics Department, Upton, New York 11973). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1394-1403(Apr 1981).

Photon strength functions have been derived from discrete neutron resonance data for electric and magnetic dipole radiation using the methods of slow neutron time-of-flight spectroscopy. The data cluster reasonably well around strengths of b(E1-tilde)=0.04 Weisskopf units/MeV and b(M1)=1.4 Weisskopf units/MeV, respectively.

17740 **Effect of exchange-energy corrections on self-consistent meson masses and on the equation of state of nuclear matter.** Kapusta, J.I. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review, The, C. Nuclear Physics ;* **23**: No. 4, 1648-1655(Apr 1981).

An estimate is made of the effect of expanding about the full nucleon and meson propagators as well as the mean meson fields in certain model renormalizable relativistic field theories of nuclear matter. Meson masses are determined self-consistently by satisfying, at zero momentum only, the Schwinger-Dyson equations which result when the energy functional is truncated at the two-loop level. The tachyonic pion problem of the standard mean field ex-

pansion is eliminated but the opposite problem of a far too massive pion in normal nuclear matter arises.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 17732

17741 (SLAC—239, pp 177-191) **Instrumentation.** Ritson, D. Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

In this talk some of the basic processes that occur when a charged particle passes through a medium are described. A charged particle traversing a medium loses energy by a number of mechanisms. The most important mechanisms are: (1) Cerenkov radiation: when the velocity of the particle exceeds the velocity of light in the medium, it will radiate via the Cerenkov effect; (2) transition radiation: when the particle traverses a dielectric boundary, it will radiate transition radiation; (3) ionization losses: passage of a particle through a medium leads to ionization and excitation of the atoms of the medium. The secondarily produced electrons, in turn, by the same mechanism, lead to further ionization. The description of Cerenkov radiation and transition radiation effects are omitted and ionization losses are covered in this talk.

17742 (SLAC—239, pp 559-572) **Dipole moments and parity violating spin rotations of the neutron.** Ramsey, N.F. (Harvard Univ., Cambridge, MA). Jan 1981.

From SLAC/Summer Institute conference on the weak interaction; Menlo Park, CA, USA (28 Jul 1980).

Four different categories of experiments involving slow neutrons are discussed: (1) the most recently completed experiments at the Institut Laue-Langevin (ILL) and at Leningrad which set an upper limit on the electric dipole moment of the neutron, (2) the new experiment now being assembled at the ILL to measure the neutron electric dipole moment with ultra-cold neutrons trapped by total reflection in a neutron bottle, (3) a recent measurement of the neutron magnetic moment at the ILL with an improvement in accuracy by a factor of more than one hundred, (4) the recent observation at the ILL of a parity violating spin rotation when neutrons pass through matter, due, presumably, to the parity violating weak interaction.

6550 Medical Physics

REFER ALSO TO CITATION(S) 17274, 17283, 17298, 17305, 17308, 17312, 17506, 17507

17743 **(LBL—11652) Practical neutron dosimetry at high energies.** McCaslin, J.B.; Thomas, R.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1980. Contract W-7405-ENG-48. 40p. (CONF-8010168—1). NTIS, PC A03/MF A01.

From European seminar on radiation protection quantities for external exposure; Braunschweig, F.R. Germany (13 Oct 1980).

Dosimetry at high energy particle accelerators is discussed with emphasis on physical measurements which define the radiation environment and provide an immutable basis for the derivation of any quantities subsequently required for risk evaluation. Results of inter-laboratory dosimetric comparisons are reviewed and it is concluded that a well-supported systematic program is needed which would make possible detailed evaluations and inter-comparisons of instruments and techniques in well characterized high energy radiation fields. High-energy dosimetry is so coupled with radiation transport that it is clear their study should proceed concurrently.

17744 **(ORNL/TM—7415) Comparison of 50-year and 70-year internal-dose-conversion factors.** Ryan, M.T.; Dunning, D.E. Jr. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 43p. NTIS, PC A03/MF A01.

The 50-year inhalation and ingestion dose commitments associated with an acute intake (of a radionuclide) of 3.7 x 10^4 Bq (1 μCi) in one day were compared with the corresponding dose commitments calculated for a 70-year integration period resulting from a chronic intake of the same amount at a rate of 101 Bq/d (0.00274 μCi/d) for one year. These values, known as dose conversion factors, estimate the dose accumulated during a given period of time following a unit of intake of a radionuclide. It was demonstrated that the acute intake of 3.7 x 10^4 Bq in one day and the chronic intake of 101 Bq/d for one year (a total intake of 3.7 x 10^4 Bq) result in essentially the same dose commitment for a relatively long integration period. Therefore, the comparison of 50-year acute dose conversion factors and 70-year chronic dose conversion factors is essentially only a measure of the additional dose accumulated in the 50 to 70 year period. It was found that for radionuclides with atomic mass less than 200 the percent difference in the 70-year and 50-year dose conversion factors was essentially zero in most cases. Differences of approximately 5 to 50% were obtained for dose conversion factors for most alpha emitters with atomic masses of greater than 200. Comparisons were made on the basis of both organ dose equivalent and effective dose equivalent. The implications and significance of these results are discussed.

17745 **(SLAC-PUB—2662) Neutron measurements.** McCall, R.C. (Stanford Linear Accelerator Center, CA (USA)). 1981. Contract AC03-76SF00515. 4p. (CONF-810103—2). NTIS, PC A02/MF A01.

From Measurement science conference; Anaheim, CA, USA (30 Jan 1981).

Methods of neutron detection and measurement are discussed. Topics include sources of neutrons, neutrons in medicine, interactions of neutrons with matter, neutron shielding, neutron measurement units, measurement methods, and neutron spectroscopy. (ACR)

6560 Solid State Physics

REFER ALSO TO CITATION(S) 17142, 17596

17746 **(DOE/ER/02305—T1) Electron-dislocation interactions at low temperatures. Progress report.** (Connecticut Univ., Storrs (USA)). 1981. Contract AS02-76ER02305. 10p. NTIS, PC A02/MF A01.

In the last year the following experiments have been carried out: (A) magneto-oscillations have been observed in the dislocation drag process, (B) a rotational peak has been observed; this peak is related to the rotation of a magnetic field relative to the slip plane of deforming crystal, (C) twinning of a zinc crystal was shown to be related to the velocity of the dislocations involved. This correspondence between the nucleation of dislocation twinning and dislocation velocity has not been observed before.

17747 **(DOE/ER/05002—16) Coincidence lattice model for the structure and energy of grain boundaries.** Brokman, A.; Balluffi, R.W. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1981. Contract AS02-78ER05002—16. 54p. NTIS, PC A04/MF A01.

It is proposed that, to a good approximation, the construction of a boundary can be described in terms of three basic steps: (1) a rigid body joining of two perfect crystals along the boundary plane (Step I); (2) a primary relaxation (Step II) consisting of relaxations in the boundary centered on O-Lattice elements which act to improve lattice matching in these regions; and (3) a possible secondary relaxation (Step III) which produces the final structure composed of patches of a low Σ boundary and secondary grain boundary dislocations. The energy after Step I is obtained by summing pairwise interactions across the boundary and is found to be relatively low for a number of low Σ boundaries and to approach a larger constant value for all large Σ boundaries. The energy decrease due to Step II varies monotonically with crystal misorientation according to a Read-Shockley function, and the energy decrease associated with Step III produces cusps in the energy versus misorientation curve at misorientations corresponding to low Σ boundaries. The model appears to be consistent with the present knowledge of boundary structure and energy, and its general applicability is discussed.

17748 (DOE/ER/10375—T1) Study of the motion of electrons in non polar classical liquids. Measurement of Hall effect and f.i.r. search for low energy traps. Progress report. (Purdue Univ., Lafayette, IN (USA)). 10 Mar 1981. Contract AS02-79ER10375. 12p. NTIS, PC A02/MF A01.

Progress is reported on experiments aimed at the measurement of the Hall mobility of injected electrons in classical non polar insulating liquids and the optical absorption associated with electrons captured by shallow traps in the liquefied rare gases. Theoretical work aimed at a better understanding of the trapping kinetics of electrons by SF_6 and O_2 dissolved in rare gas liquids was also carried out. Its conclusion is that the electric field dependence of the trapping probability can be explained, basically without adjustable parameters, by considering the Poole-Frenkel-Schotky ionization of the excited state of the traps. From the analysis of published data on the motion of electrons in liquid ethane it is tentatively concluded that at low temperatures the trapping of electrons in the liquid involves a Jahn-Teller like distortion of a single ethane molecule while at higher temperatures it is necessary to consider a small molecular cluster, possibly made up of 2 molecules.

17749 (DOE/ER/10436—2) Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb. Perkowitz, S. (Emory Univ., Atlanta, GA (USA)). 23 Feb 1981. Contract AS05-79ER10436. 7p. NTIS, PC A02/MF A01.

Optical techniques in the far infrared region (10 to 200 cm^{-1}) are to explore the basic superconducting behavior of the high temperature superconductors V_3Si, Nb_3Ge, Nb, and granular NbN. Such spectroscopy yields accurate gap values, information about the temperature dependence of superconducting properties, values of the electron-phonon spectral function, and insight into grain-to-grain coupling in inhomogeneous geometries. These results are used to calculate basic superconducting parameters such as the coupling constant and the transition temperature with the aim of explaining the underlying physics of superconductors.

17750 (DOE/ER/10440—2) Determinations of lattice and electronic structures of solids by electron scattering. Progress report. Gibbons, P.C. (Washington Univ., St. Louis, MO (USA). Dept. of Physics). 4 Mar 1981. Contract AS02-79ER10440. 29p. NTIS, PC A03/MF A01.

A discussion is presented of the final results of a study of the causes of finite widths of plasmons as observed in energy loss spectra. The performance of the imaging spectrometer is described, along with methods used for the analysis of EXAFS data and the tests made of those methods. (GHT)

17751 Self-consistent phonon approximations for the solid phase of a one-component plasma. Albers, R.C.; Gubernatis, J.E. (Los Alamos Scientific Lab., NM). *Physical Review [Section] B: Condensed Matter ;* **23**: No. 6, 2782-2796(15 Mar 1981).

We applied the self-consistent harmonic (SCH) approximation to the solid phase of the one-component plasma (OCP) to study effects of anharmonicity on its melting transition and equation of state. We calculated both the zero-temperature (Wigner lattice) and high-temperature (classical OCP) limits and compared the high-temperature results with those of Monte Carlo simulations. The principal findings are that the anharmonic effects are generally small, the dynamic instability in the SCH is unrelated to the melting transition, and except near the instability the SCH predicts anharmonic contributions to the internal energy opposite in sign from those found in the high-temperature Monte Carlo simulations. We also studied two simpler self-consistent phonon approximations, the self-consistent Einstein and Debye approximations, and report their zero- and high-temperature predictions.

17752 Density of states and the velocity autocorrelation function derived from quench studies. Grest, G.S.; Nagel, S.R.; Rahman, A.; Witten, T.A. Jr. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Journal of Chemical Physics, The ;* **74**: No. 6, 3532-3534(15 Mar 1981).

We show how, for a harmonic solid, the density of normal mode states and the velocity autocorrelation function can be found by analyzing the temperature of the solid after its kinetic energy has been abruptly quenched. In a molecular dynamics simulation of an interacting Lennard-Jones system we show what happens to these results as the solid is made anharmonic and how, in the liquid state, these techniques can be used to study the role of anharmonicity in the velocity autocorrelation function.

17753 Propagation of sound in a spin-glass. Hertz, J.A.; Khurana, A.; Klemm, R.A. (Univ. of Chicago, IL). *Physical Review Letters ;* **46**: No. 7, 496-499(16 Feb 1981).

Sound propagation and damping near the spin-glass transition for a time-dependent Landau-Ginzburg model coupled to phonons is studied. The sound speed decreases linearly with T-T/sub g/, and the sound damping diverges as (T-T/sub g/)$^{-1}$, when the spin-glass transition, T/sub g/, is approached from high temperatures. At the spin-glass transition, the sound speed has a term proportional to ω/sup 1/2/, and the sound damping is proportional to ω/sup -1/2/.

6561 Superconductivity

REFER ALSO TO CITATION(S) 17128, 17135

17754 (DOE/ER/04938—T1) Superconductivity in filamentary eutectic composites. Progress report, June 1, 1980-May 31, 1981. Zaitlin, M.P. (Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy). 1981. Contract AS02-78ER04938. 12p. (COO—4938-4). NTIS, PC A02/MF A01.

The ac magnetic susceptibility of the Nb-Th eutectic composites in a dc magnetic field showed the existence of a mixed state in the thorium matrix material even in large fields of several kilogauss. This mixed state persisted until nearly the field at which superconductivity in the niobium filaments was destroyed. Measurements of the upper critical field H/sub c2 parallel/ were independent of filament diameter (from $\leqq$ 100A to $\geqq$ 1000A) and showed less anistropy than expected. The upper critical field was nearly linear in T/sub c/-T which is indicative of an anisotropic Fermi surface. Extrapolated to zero temperature the values are H/sub c2 parallel/ = 11.5 kG and H/sub c2 perpendicular/ = 8.5 kG which correspond to coherence lengths of zeta/sub parallel/ = 170A and zeta/sub perpendicular/ = 200A. The ac susceptibility measurements could not be used to find the lower critical field H/sub c1/ because the mixed state gave the sample too short a skin depth.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 17213, 17678

17755 (LA-UR—81-994) Whispering-mode waveguide. Kurnit, N.A. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 37p. (CONF-810429—5). NTIS, PC A03/MF A01.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

Properties of a relatively new type of waveguide structure of potential use for confining infrared radiation to a small mode volume over long path lengths are reviewed. A single guiding surface with curvature radius rho and band radius R allows propagation of a near-grazing incidence whispering mode of transverse width $\sim(\lambda \sqrt{\text{rho}R/\pi})$/sup 1/2/ and radial width $\sim$ 1/2 $(\lambda^2 R)$/sup 1/3. For sufficiently large rho, the loss per revolution for TE mode propagation is $\sim\pi$A/sub N/, where A/sub N/ is the normal-incidence reflection loss. Results on a number of prototype structures in general agreement with these considerations is described.

17756 Reality and significance of the Aharonov-Bohm effect. Greenberger, D.M. (Massachusetts Inst. of Tech., Cambridge, MA). Contract EY-76-C-02-3069. *Physical Review, The, D. Particles and Fields ;* **23**: No. 6, 1460-1462(15 Mar 1981).

Because the Aharonov-Bohm effect has been challenged on mathematical grounds we give a simple physical proof of its existence, which also gives an insight into why such a strange effect

must exist within quantum theory. We also comment on some of the recent literature on the subject.

17757 **Fringing fields and criticisms of the Aharonov-Bohm effect.** Lipkin, H.J. (Argonne National Laboratory, Argonne, IL). Contract W-31-109-ENG-38. *Physical Review, The, D. Particles and Fields ;* **23**: No. 6, 1466-1467(15 Mar 1981).

A recent paper attributes the Aharonov-Bohm effect to the fringing field leaking out of a finite solenoid rather than to the magnetic flux in the excluded region. This argument is seen to be absurd for a very long solenoid where the effect is attributed to the tail of the electron wave function very far from the point of measurement, and is completely refuted by toroidal geometry with no fringing field.

17758 **Variable phase method for the calculation of the scattering phase shift: the bound-state region.** Clifton, J.M.; Leacock, R.A. (Iowa State Univ. of Science and Technology, Ames). Contract W-7405-ENG-82. *Journal of Computational Physics ;* **38**: No. 3, 327-377(Dec 1980).

Variable phase methods for the calculation of the scattering phase shift in non-relativistic, quantum mechanical potential scattering are investigated with emphasis on their use for negative energies (bound-state region) and general (not necessarily integral) angular momenta. Of the various phase methods known to be valid for positive energies (scattering region), some remain valid and some become invalid for negative energies. One of the phase methods demonstrated to be valid for both positive and negative energies is fast for numerical computation of the scattering phase shift and so is useful for phenomenological investigations.

6580 Mathematical Physics

17759 **Heuristic model of the nonlinear Rayleigh-Taylor instability.** Baker, L.; Freeman, J.R. (Particle Beam Fusion Dept., 4240 Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics ;* **52**: No. 2, 655-663(Feb 1981).

A simple model is derived heuristically for the nonlinear evolution of the Rayleigh-Taylor instability. Ordinary differential equations for time evolution of the spike and bubble amplitudes are found by constructing terms that smoothly connect the regimes of small and large amplitude behavior. The results apply to arbitrarily varying acceleration fields, including shock-induced instabilities. The model predicts amplitudes accurate to better than 20% (velocity predictions are more accurate), in comparisons with published experimental data and two-dimensional numerical simulations with hydrocodes. A limitation in the present model is that the density ratio of the two fluids should not be close to one for accurate modeling.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 17688, 17886, 17888

17760 **(DOE/ET/53048—3) Collision cross sections and equilibrium fractions of ions and atoms in metal vapor targets. Project progress report, June 1, 1979-May 31, 1980.** Morgan, T.J. (Wesleyan Univ., Middletown, CT (USA)). 1980. Contract AS02-76ET53048. 7p. NTIS, PC A02/MF A01.

The objective of this program is to measure atomic collision cross sections and equilibrium fractions of ions and atoms in metal vapor targets. The goal is to obtain experimental information on atomic collision processes relevant to the Magnetic Fusion Energy Program. In particular, in connection with the development of double charge exchange D^- ion sources, we are measuring D^- formation cross sections in alkaline-earth metal vapor targets. During the period covered in this report we have measured electron transfer cross sections for 3-40 keV D^+ ions and D^0 atoms in collision with calcium vapor.

17761 **(GA-A—16194) Radio frequency current drive in fusioning plasma.** Chu, C.; Bhadra, D. (General Atomic Co., San Diego, CA (USA)). Feb 1981. Contract AT03-76ET51011. 8p. (CONF-810214—4). NTIS, PC A02/MF A01.

From 4. topical conference on radio frequency plasma heating; Austin, TX, USA (9 Feb 1981).

A method for driving current in a fusioning plasma is proposed. Radio frequency power is used to prohibit the fusion-produced α-particles from slowing down isotropically, or to push the α-particles in a preferential direction and thus form an α-particle beam. As a result, a net plasma current (Ohkawa current) may be generated if the fuel ions have Z not equal to 2. The power requirement is estimated and the efficiency is found to be comparable to beam and other rf current-drive schemes. Since the α-particles are born in the central hot core of the reactor, the current profile is naturally peaked in the center.

17762 **Threshold conditions for laser-initiated plasma shutters.** Czuchlewski, S.J.; Figueira, J.F. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. *Applied Physics Letters ;* **38**: No. 5, 325-327(1 Mar 1981).

The characteristics of laser-initiated plasma shutters used for retropulse isolation in high-power CO_2 laser-fusion systems are discussed. Initiation of the plasma breakdown is shown to depend on the fluence that is incident on the edge of the iris which is employed in these shutters. A relatively simple model for the ignition process has been verified for a range of pulse durations (0.7 to 60 ns) and iris diameters (100 to 800 μm). This model provides practical design criteria for sizing plasma isolators for a variety of applications.

17763 **(LA—8161-M) Plasma physics plotting package.** Hyman, D.H. (Los Alamos National Lab., NM (USA)). Feb 1981. Contract W-7405-ENG-36. 134p. NTIS, PC A07/MF A01.

We describe a package of plotting routines that do up to six two- or three-dimensional plots on a frame with minimal loss of resolution. The package now runs on a PDP-10 with PLOT-10 TCS primitives and on a Control Data Corporation-7600 and a Cray-1 with TV80LIB primitives on the National Magnetic Fusion Energy Computer Center network. The package is portable to other graphics systems because only the primitive plot calls are used from the underlying system's graphics package.

17764 **(LA—8425-MS) Pulsed versus direct current calibration of a proximity focused x-ray streak camera.** Rockett, P.D.; McGurn, J.S. (Los Alamos Scientific Lab., NM (USA)). Feb 1981. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01.

The absolute sensitivity of a proximity focused x-ray streak tube was measured with dc Henke tube x-ray line sources. Calibration covered the photon energy range from 0.930 to 8.05 keV at five points. These data were compared to a model of sensitivity based on photocathode response and matched the model well on a relative scale. A pulsed comparison was performed using a laser-plasma x-ray source. The calculated camera sensitivity was folded with the measured spectrum and compared to measured film exposures. The predicted exposures were 6.5 times less than the measured exposures, verifying concerns that the proximity focused tube response is nonlinear with flux at low, dc flux levels. Results of dc recalibrations that varied flux levels determined the extent of this phenomenon.

17765 **(LA—8729-MS) Observations of plasma tearing instabilities and associated axial translation in field-reversed experiments.** Armstrong, W.T.; Cochrane, J.C.; Lipson, J.; Tuszewski, M. (Los Alamos Scientific Lab., NM (USA)). Feb 1981. Contract W-7405-ENG-26. 55p. NTIS, PC A04/MF A01.

Tearing and reconnection processes during the formation and quiescent periods of a field-reversed configuration are studied with an axial array of compensated diamagnetic loops. Several representative plasma shots are documented.

17766 **(LA—8738-MS) Method of inferring the magnetic field profiles in the reversed-field pinch.** Gerwin, R. (Los Alamos Scientific Lab., NM (USA)). Mar 1981. Contract W-7405-ENG-36. 14p. NTIS, PC A02/MF A01.

A diagnostic procedure is proposed that displays the toroidal and poloidal magnetic field profiles in the form of power series, through r^6. In addition to the usual external measurements, only one internal point magnetic measurement is required, if cylindrical symmetry and pressure balance are assumed. (The plasma pressure profile is also assumed to be measured nonintrusively; alternatively, it might be ignored if beta is known to be sufficiently small). The (zero-beta) method is tested here against full magnetic-profile shot-averaged data obtained from a multiple-probe device in ZT-40 with a ceramic liner. The agreement is quite good. The procedure seems simple enough for on-line use in RFP experiments. The availability of such profiles should enhance the effective application of theory to the RFP.

17767 **(LA-UR—81-682) ICRF oscillations of an inhomogeneous plasma cylinder.** Cayton, T.E.; Lewis, H.R. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-26. 5p. (CONF-810214—5). NTIS, PC A02/MF A01.

From 4. topical conference on radio frequency plasma heating; Austin, TX, USA (9 Feb 1981).

We have derived a dispersion differential equation suitable for studying free and forced oscillations of a radially inhomogeneous plasma cylinder in the ion cyclotron range of frequencies (ICRF). Solving the differential equation, subject to appropriate boundary conditions, yields global eigenmodes of the cylindrical configuration; thus, our description embraces both the geometry and the physics relevant in the ICRF. The derivation begins with the equations of the Vlasov(ion)-fluid(electron) model. An approximate solution of the ion Vlasov equation is obtained analytically for a general screw pinch equilibrium by restricting the ion gyroradius to small, but finite values.

17768 **(LA-UR—81-896) Lasers as a tool for plasma diagnostics.** Jahoda, F.C. (Los Alamos Scientific Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 30p. (CONF-810429—3). NTIS, PC A03/MF A01.

From Conference on optics; Santa Fe, NM, USA (6 Apr 1981).

Lasers can be used as non-perturbative probes to measure many plasma parameters. Plasma refractivity is primarily a function of electron density, and interferometric measurements of phase changes with either pulsed or CW lasers can determine this parameter with spatial or temporal resolution over several orders of magnitude sensitivity by using laser wavelengths from the near uv to the far infrared. Laser scattering from free electrons yields the most fundamental electron temperature measurements in the plasma parameter range where individual scattering events are uncorrelated in phase and ion temperature or plasma wave and turbulence structure in the opposite limit. Laser scattering from bound electrons can be many orders of magnitude larger if the laser is matched to appropriate resonance frequencies and can be used in specialized circumstances for measuring low-ionized impurity or dominant species neutral concentrations and velocities.

17769 **(LAPS—71) Studies of emission and transport of synchrotron radiation in tokamaks.** Tamor, S. (Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies). 16 Mar 1981. Contract AC03-76ET53057. 26p. (SAI—023-81-110LJ). NTIS, PC A03/MF A01.

An elementary qualitative discussion is given of the transport of synchrotron radiation in a magnetized plasma. A summary is given of the actual computational results. These results are compared with the qualitative description of the preceding section. The conclusions to be drawn with respect to both the physics of advanced fuel reactors and better computational methods are outlined.

17770 **(ORNL/Sub—7676/1) Research support for plasma diagnostics on Elmo Bumpy Torus: investigation of diamagnetic diagnostics for the electron rings.** Carpenter, K.H. (Missouri Univ., Rolla (USA). Dept. of Electrical Engineering). Feb 1981. Contract W-7405-ENG-26. 111p. NTIS, PC A06/MF A01.

Diamagnetic diagnostics for the EBT electron rings are fundamental to the experiment. The diamagnetic flux pickup loops on each cavity output signals proportional to ring perpendicular energy. A data analysis technique is described, which in its simplest form is subtracting 1/4 the signal from each neighboring cavity pickup loop from the central one's, which provides a signal proportional to the energy in a single ring. The calibration factor relating absolute perpendicular energy to diamagnetic signal depends weakly on the geometrical model for the ring. Calculations with a bumpy cylinder MHD equilibrium code give calibration factors in reasonable agreement (20%) to the values obtained using a simple, concentric cylindrical current sheet model. The cylindrical current sheet model is used to show that diamagnetic field components measured external to the plasma require high precision or correlation with other diagnostics in order to fix model parameters. A computer simulation shows an assumption of constant ring thickness and energy density with increasing length (and energy) is compatible to diamagnetic field observations on NBT.

17771 **(ORNL/TM—7132) 3-D nonlinear calculations of resistive tearing modes.** Hicks, H.R.; Holmes, J.A.; Lee, D.K.; Carreras, B.; Waddell, B.V. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 56p. NTIS, PC A04/MF A01.

Recent numerical calculations of the evolution of resistive tearing modes have been central to the understanding of magnetohydrodynamic activity and disruptions in tokamaks. The nonlinear, 3-D, initial-value computer code RSF has provided many of these results. This code assumes cylindrical geometry with a Fourier series representation in the two periodic coordinates and a finite-difference representation in the radial direction. This choice makes RSF considerably more accurate and efficient than previous codes.

17772 **(ORNL/TM—7616) Variational moment solutions to the Grad-Shafranov equation.** Lao, L.L.; Hirshman, S.P.; Wieland, R.M. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 51p. NTIS, PC A04/MF A01.

A variational method is developed to find approximate solutions to the Grad-Shafranov equation. The surfaces of the constant poloidal magnetic flux psi (R,Z) are obtained by solving a few ordinary differential equations, which are moments of the Grad-Shafranov equation, for the Fourier amplitudes of the inverse mapping R(psi, θ) and Z(psi, θ). Analytic properties and solutions of the moment equations are considered. Specific calculations using the Impurity Study Experiment (ISX-B) and the Engineering Test Facility (ETF)/International Tokamak Reactor (INTOR) geometries are performed numerically, and the results agree well with those calculated using standard two-dimensional equilibrium codes. The main advantage of the variational moment method is that it significantly reduces the computational time required to determine two-dimensional equilibria without sacrificing accuracy.

17773 **(ORNL/TM—7675) US-Japan Workshop on atomic-collision data for fusion.** Crandall, D.H.; Hafford, P.M.; Itikawa, Y. (eds.). (Oak Ridge National Lab., TN (USA)). Apr 1981. Contract W-7405-ENG-26. 82p. NTIS, PC A05/MF A01.

This report, containing abstracts of each of the presentations and discussions, includes: brief talks on the applications of atomic data in tokamaks and in inertial confinement; reviews of the specific atomic collisions projects for fusion in Japan and the United States; discussions of how the data centers operate and manner of exchanging data; brief reviews of the status of electron-ion scattering and ion-atom scattering; discussions of criteria to be used in evaluating and selecting both experimental and theoretical data in these two areas; comparisons of data selected for each of six specific collision reactions which were evaluated by both groups prior to the workshop; brief reviews of activities in the related areas of atomic struc-

ture and plasma wall interactions; and a decision to pursue a joint or collaborative compilation of recommended cross sections for oxygen ions for electron impact excitation and electron capture from atomic hydrogen.

17774 **(PPPL—1729) Fast-wave ion-cyclotron heating in the Princeton Large Torus.** Hosea, J.; Boyd, D.; Bretz, N. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1981. Contract AM02-76CH03073. 21p. NTIS, PC A02/MF A01.

Recent experimental results for ICRF heating in PLT are presented. For the two-ion regime in D-H or D-^{3}He plasmas minority H and ^{3}He ions are found to absorb the rf power and transfer it to the deuterons and electrons in accordance with Fokker-Planck theory. The deuteron heating rate is $\sim$ 3 eV x 10^{13} cm^{-3}/kW for H and $\sim$ 6 eV x 10^{13} cm^{-3}/kW for ^{3}He minorities. Neutron fluxes of $\sim$ 3 x 10^{11} sec^{-1} corresponding to a T/sub d/ $\sim$ 2 keV (ΔT/sub d/ $\sim$ 1.2 keV) have been produced with P/sub rf/ $\approx$ 620 kW at anti n/sub e/ $\approx$ 2.9 x 10^{13} cm^{-3}. Neutron energy spectra and mass sensitive charge exchange spectra indicate Maxwellian deuteron distributions. In addition, D-^{3}He fusion reaction rates $\geqq$ 10^{12} sec^{-1} have been produced by the energetic ^{3}He ions. For the second harmonic regime, initial heating results for an H plasma at P/sub rf/ $\approx$ 140 kW are consistent with the Fokker-Planck theory and the bulk heating rate is comparable to that of D heating in the D-H minority regime.

17775 (PPPL—1755, pp 20-25) **Experiment on plasma confinement by intense relativistic electron beam ring.** Tomita, Y.; Narihara, K.; Tsuzuki, T.; Hasegawa, M.; Ikuta, K.; Mohri, A. (Nagoya Univ., Japan). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In SPAC-V, REB rings with a current of 30 kA and milliseconds life were successfully formed using a new injection method in which plasma acts as anode and no anode foil is needed. Encouraged by the results from the SPAC-V experiments, we have constructed a scale-up toroidal device SPAC-VI which was designed aiming at longer life and higher current of REB rings. In the new toroidal device SPAC-VI, the strong adiabatic compression is easily applicable, when the beam electrons and the plasma are both energized. A summary of the results of the SPAC-V experiment is given. The design and experimental results from SPAC-VI are presented.

17776 (PPPL—1755, pp 49-52) **Thermal background effects on the kink instability of a field-reversing ion layer.** Yakura, S.J.; Kammash, T. (Univ. of Michigan, Ann Arbor). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Earlier work is extended by including the thermal effects of the background plasma and examining its impact on the stability of the kink modes.

17777 (PPPL—1755, pp 53-56) **Magnetized gun experiments.** Jarboe, T.R.; Henins, I.; Hoida, H.W.; Marshall, J.; Sherwood, A.R. (Los Alamos Scietific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In the Los Alamos Magnetized Gun Experiment we are attempting to produce a compact torus in a manner similar to an earlier experiment of Alfven. In our experiment a solenoidal coil is placed inside the inner electrode of a coaxial plasma gun. This coil produces an axial magnetic field inside the inner electrode which diverges and becomes a largely radial field in front of the gun muzzle. The idea is that when the gun is fired, the plasma escaping from the gun stretches these radial fields along the axial direction away from the gun, and these field lines can reconnect behind the plasma forming the poloidal field of the compact torus. The magnetic field generated by the gun current becomes the toroidal field and the major axis of the compact torus will be the same as the axis of the coaxial gun. Recent interest in this possible method of compact torus generation was stimulated by C. Hartman, and the approach is also being pursued in the field-reversed plasma gun experiment at LLL.

17778 (PPPL—1755, pp 57-60) **Formation of a compact torus using a toroidal plasma gun.** Levine, M.A.; Pincosy, P.A. (Univ. of California, Berkeley). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Myers, Levine and Pincosy earlier reported results using a toroidal plasma gun. The device differs from the usual coaxial plasma gun in the use of a strong toroidal bias current for enhanced efficiency, a pair of disk-like accelerating electrodes for reduced viscosity and a fast pulsed toroidal gas valve for more effective use of the injected gas sample. In addition, a technique is used for generating a toroidal current in the plasma ring. The combination offers an opportunity to deliver a plasma with a large amount of energy and to vary the density and relative toroidal and poloidal magnetic field intensities over a range of values. It is the purpose of this paper to report further experimental results, to project the gun's applications to the formation of a compact torus, and to propose a simple modification of the present apparatus as a test.

17779 (PPPL—1755, pp 68-71) **Formation of toroidal plasma confinement configurations by using hot electrons.** Hartman, C.W. (Lawrence Livermore Lab., CA); Levine, M.A. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

This note discusses possible means of producing closed, toroidal pinch-like configurations with hot electrons starting from a collisionless, mirror-confined, hot electron plasma. The final configurations are directly related to Spheromak, Tormac, and the stabilized Z-pinch.

17780 (PPPL—1755, pp 76-79) **Two dimensional time-dependent transport in field reversed equilibria.** Auerbach, S.P.; Berk, H.L.; Boyd, J.K.; McNamara, B.; Shumaker, D. (Lawrence Livermore Lab., CA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A study was made of the buildup, steady state, and decay of field-reversed mirrors, with emphasis on studying effects of neutral beams.

17781 (PPPL—1755, pp 82-85) **Calculation of ideal MHD growth rates and eigenfunctions in field reversed mirrors in the large toroidal mode number limit.** Anderson, D.V. (Univ. of California, Livermore); Newcomb, W.A.; Barnes, D.C. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The observation of MHD stable configurations in field reversed theta pinches has led us to review the ideal MHD stability theory. We produce 2D, r,z equilibria from assorted models, including Hill's vortex, which are intended to match various profiles measured in experiments such as the FRX series at Los Alamos. These equilibria are used as the starting point for several stability calculations.

17782 (PPPL—1755, pp 89-93) **Some properties of the heating and confinement in the RFP configuration.** Ortolani, S. (Padova Univ., Italy). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In this paper some properties of RFP plasmas as observed in the ETA-BETA II experiment are discussed; and some comments on scaling laws appropriate to the RFP are presented. The main experimental parameters of ETA-BETA II are summarized and the time evolution of the toroidal plasma current, I sub phi/ and of the toroidal field at the vacuum wall, B/sub phi/, is sketched.

17783 (PPPL—1755, pp 94-97) **Relaxation of toroidal discharges.** Turner, L. (Los Alamos Scientific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The variational principle of Taylor provides the guiding spirit for calculations concerning the relaxation of turbulent plasma discharges. The principle states that a turbulent, high-magnetic-

Reynolds-number plasma confined by a perfectly conducting shell will achieve the state of minimum magnetic energy consistent with specified magnetic helicity and magnetic flux. It yields the Euler equation V vector x B vector = λ B vector where, for reversed-field pinch geometries, the eigenvalue λ is a continuous variable that specifies the ratio of net toroidal current to net toroidal magnetic flux.

17784 (PPPL—1755, pp 98-101) **Effects of impurity radiation on reversed-field pinch evolution.** Caramana, E.J.; Perkins, F.W. (Plasma Physics Lab., Princeton, NJ). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Spheromak and reversed-field pinch plasmas share the property that Ohmic heating must overcome strong radiative cooling by oxygen impurity atoms which peaks at a temperature T/sub o/ ≃ 25 eV. We present results of transport code studies of this phenomenon, for several reversed-field pinch devices, and summarize these results in terms of two nondimensional parameters which parametrize the impurity content and the device size.

17785 (PPPL—1755, pp 102-105) **Field reversal experiments: FRX-A and FRX-B results.** Armstrong, W.T.; Linford, R.K.; Lipson, J.; Platts, D.A.; Sherwood, E.G. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The equilibrium, stability, and confinement properties of the Field Reversed Configuration (FRC) are being studied in two theta pinch facilities referred to as FRX-A, and FRX-B. The configuration is a toroidal plasma confined in a purely poloidal field configuration containing both closed and open field lines. The FRX system produces highly elongated tori with major radius R=3 to 5 cm, minor radius a ~ 2 cm, and a full length l ~ 35 to 50 cm. Plasma conditions have ranged from T/sub e/ ~ 150 eV, T/sub i/ ~ 800 eV, and n/sub max/ ~ 10^{15}/cm^3 to T/sub e/ ~ 100 eV, T/sub i/ ~ 150 eV, and n/sub max/ ~ 4 x 10^{16}/cm^3. The plasma remains in a stable equilibrium for up to 50 μs followed by an n = 2 rotational instability which results in termination of the FRC. The plasma behavior with respect to equilibrium, stability, and rotation is consistent with recent theoretical work in these areas.

17786 (PPPL—1755, pp 106-109) **FRX-C and multiple-cell experiments.** Siemon, R.E. (Los Alamos Scientific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Two new compact torus experiments have recently been proposed and one (FRX-C) is now under construction. The proposed experiments are based on recent theoretical advances and experimental results obtained with the LASL FRX-A and FRX-B field-reversed theta-pinch devices. These recent experiments demonstrate a formation method and establish some of the confinement properties for one type of plasma compact torus - an elongated prolate plasma torus confined by purely poloidal magnetic field. The plasma displays a quiescent phase, either characteristic MHD times or an open-field line that persists much longer than either characteristic MHD times or open-field line loss times. The quiescent phase is terminated by an n = 2 mode that is correlated experimentally with a steadily increasing plasma rotation that eventually exceeds the theoretically predicted threshold for instability (approximately 1.5 Ω* where Ω* is the angular diamagnetic drift frequency).

17787 (PPPL—1755, pp 110-114) **Compact torus theory: MHD equilibrium and stability.** Barnes, D.C. (Los Alamos Scientific Lab., NM); Seyler, C.E.; Anderson, D.V. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Field reversed theta pinches at Los Alamos and elsewhere have demonstrated the production and confinement of compact toroidal configurations with surprisingly good MHD stability. In these observations, the plasma is either lost by diffusion or by the loss of the applied field or is disrupted by an n = 2 (where n is the toroidal mode number) rotating instability only after 30 to 100 MHD times, when the configuration begins to rotate rigidly above a critical speed. These experiments have led us to investigate the equilibrium, stability, and rotation of a very elongated, toroidally axisymmetric configuration with no toroidal field. Many of the above observations are explained by recent results of these investigations which are summarized here.

17788 (PPPL—1755, pp 115-117) **Two-dimensional simulation of compact torus formation.** Hewett, D.W. (Los Alamos Scientific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The FRX formation studies are accomplished by simulating the time evolution of a homogeneous plasma with a negative bias B/sub z/-field (-500 gauss) which is subjected at t = 0 to an external implosion B/sub z/-field (5 KG). The implosion field drives the plasma toward the axis where it exhibits rapid radial oscillations for a period of about 1.5 μs. After this initial chaotic behavior, the plasma settles into a configuration which, while not yet in thermal equilibrium, attains the macroscopic appearance of an infinitely long field reversed θ-pinch configuration. A figure shows the ion particle positions in R to Z space at this time. The surrounding magnetic flux contour is also shown.

17789 (PPPL—1755, pp 122-125) **Tearing-mode stability analysis of a cylindrical plasma.** Berk, H.L.; Sayer, J.; Schnack, D.D. (Univ. of California, Livermore). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Reversed field θ-pinch experiments exhibit long lifetimes, and the question of stability to the tearing mode frequently arises. In this note, we use neighboring equilibrium arguments originally developed by Pfirsch to show that tearing-mode stability is strongly enhanced if two conditions are fulfilled: the first that the flux tend to be exclused in the bulk of the plasma, and the second that the plasma edge lie close to the axis.

17790 (PPPL—1755, pp 126-129) **Tilting mode in the reversed-field theta pinch.** Shestakov, A.I.; Schnack, D.D.; Killeen, J. (Lawrence Livermore Lab., CA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Preliminary results are described of a numerical investigation of the resistive stability of such devices. We employ an initial value approach in which the linearized resistive MHD equations are used to follow the time evolution of an arbitrary perturbation in a known equilibrium configuration until an exponentially growing eigenmode appears. The fastest growing mode is thus determined. This differs from previous work in that Fourier decomposition is performed only in the toroidal direction so that two-dimensional equilibria can be treated. The specific model is described briefly.

17791 (PPPL—1755, pp 130-134) **Periodic field-reversed equilibria for a multiple-cell linear theta pinch.** Meuth, H.; Ribe, F.L. (Univ. of Washington, Seattle). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Analytical solutions for azimuthally symmetric reversed-field MHD equilibria were the object of several early investigations. Recently, there has been renewed interest in these solutions, particularly in the investigation of the MHD stability of a Field-Reversed Theta Pinch. In this paper we report the possibility of producing periodic field-reversed equilibria in the High-Beta Q Machine. We give analytical solutions within the framework of a linear flux approach.

17792 (PPPL—1755, pp 135-138) **Zero dimensional modeling of field-reverse theta pinch machines.** Klevans, E.H. (Pennsylvania State Univ., University Park). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A zero-dimensional (O to D) time dependent computer model is developed to describe post-implosion behavior of field-reverse theta pinch machines. The model consists of six equations, representing the rate of change of plasma particle number, electron internal energy, and ion internal energy; radial pressure balance; axial tension balance; and the change of the flux inside the major

radius R, where B(R) = 0. It is assumed that the length l is much larger than either R or the minor radius a, so that particle and heat losses are taken to the predominately radial. However, axial losses (through the X point, for example) can be included by use of phenomenalogical coefficients in the particle and heat loss confinement times.

17793 (PPPL—1755, pp 151-154) **Plasma rotation in field-reversed theta pinches.** Steinhauer, L.C. (Mathematical Sciences Northwest, Inc., Bellevue, WA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Field-reversed plasmas (FRP) have for many years been observed to spin up and develop a destructive m = 2 instability. While the instability threshold for rotating modes has been reasonably well characterized, the cause of rotation remains obscure. Several mechanisms have been proposed to explain the rotation. The most promising seems to be the following: end shorting on open field lines causes that portion of the plasma to spin up; viscous friction then transfers the rotating motion to plasma on closed field lines. We develop theoretical models to describe this mechanism.

17794 (PPPL—1755, pp 193-196) **Compact toroidal plasma equilibrium and implications on stability.** Morikawa, G.K. (New York Univ., NY). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The present discussion is limited primarily to the close relationship between the plasma-current-density distribution (mostly poloidal J/sub p/) and the need for an external axial current I_0 to prevent unreal singular behavior in the plasma or plasma-vacuum interface. We consider the configuration which is related to spheromaks; the toroidal plasma ($p \geqq 0$) is nominally in the double-cross-hatched region, and the single-cross-hatched region represents a toroidal vacuum (or force-free pressureless plasma $p \approx 0$) region between the spherical separatrix (plus the major axis) and the plasma.

17795 (PPPL—1755, pp 197-199) **Radio frequency flux control of toroidal plasmas.** Inoue, S. (Hiroshima Univ., Japan); Itoh, K. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The basic concept of RFFC is to drive inward plasma fluxes by supplying the momentum via waves so as to compensate the outward fluxes induced by instabilities. The particle fluxes and electron heat flux due to arbitrary low frequency electromagnetic (EM) waves are given.

17796 (PPPL—1766) **MHD stability of vertically asymmetric tokamak equilibria.** Dalhed, H.E.; Grimm, R.C.; Johnson, J.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1981. Contract AM02-76CH03073. 23p. NTIS, PC A02/MF A01.

The ideal MHD stability properties of a special class of vertically asymmetric tokamak equilibria are examined. The calculations confirm that no major new physical effects are introduced and the modifications can be understood by conventional arguments. The results indicate that significant departures from up-down symmetry can be tolerated before the reduction in β becomes important for reactor operation.

17797 (PPPL—1768) **Radiation losses in PLT during neutral beam and ICRF heating experiments.** Suckewer, S.; Hinnov, E.; Hwang, D. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1981. Contract AM02-76CH03073. 36p. NTIS, PC A03/MF A01.

Radiation and charge exchange losses in the PLT tokamak are compared for discharges with ohmic heating only (OH), and with additional heating by neutral beams (NB) or RF in the ion cyclotron frequency range (ICRF). Spectroscopic, bolometric and soft x-ray diagnostics were used. The effects of discharge cleaning, vacuum wall gettering, and rate of gas inlet on radiation losses from OH plasmas and the correlation between radiation from plasma core and edge temperatures are discussed.

17798 (PPPL—1776) **Inelastic electron-ion scattering in a dense plasma.** Hatton, G.J.; Lane, N.F.; Weisheit, J.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1981. Contract AM02-76CH03073. 21p. NTIS, PC A02/MF A01.

The Born approximation was used to investigate the influence of a dense plasma on the inelastic scattering of electrons by one-electron ions. Scaled collision strengths Z^3Q for $1s \rightarrow 2s$, $1s \rightarrow 2p$ and $2s \rightarrow 2p$ transitions in an ion of arbitrary nuclear charge Z were computed for a Debye-Hueckel model of the screened Coulomb interaction. Over a wide range of screening lengths, the effect of the plasma environment is to appreciably reduce cross sections just above threshold.

17799 (SAI—254-81-102-LJ) **Omnigenous equilibria.** Catto, P.J.; Hazeltine, R.D. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Mar 1981. Contract AC03-76ET53057. 70p. (PRI—23). NTIS, PC A04/MF A01.

The conditions are obtained for confining a plasma of arbitrary asymmetry, plasma beta, and collisionality, in an equilibrium configuration free of neoclassical transport. Such omnigenous scalar pressure equilibria are shown to exist if and only if the divergence of the parallel current density vanishes, while for an anisotropic pressure other mild restrictions are needed. Explicit constraints are derived for axisymmetric torii and long-thin, low beta conventional and tandem mirrors.

17800 (SAND—81-0116) **Dynamics of vaporization and dissociation during transient surface heating, with application to vacuum arcs.** Benson, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1981. Contract AC04-76DP00789. 51p. NTIS, PC A04/MF A01.

This report describes a model of vaporization and dissociation occurring as a result of intense heating over a localized area of a material surface. The balance of heat between the input power and losses due to vaporization, as well as radiation and conduction in the material, are considered. The model includes the effect of binary mass diffusion and changes of surface stoichiometry for multiple component materials. Effects of vapor recondensation are included. The model is then applied to the description of spot heating on a vacuum arc anode through the use of a simple power feedback model. Comparison of surface temperature measurements to model predictions are used to parametrically describe the arc behavior. Finally, extensive parametric analyses showing the effect of material property variations on the arc behavior are described.

17801 (UCID—18988) **Two-wavelength HeNe laser interferometer.** Granneman, E.H.A. (Lawrence Livermore National Lab., CA (USA)). 24 Mar 1981. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01.

This paper presents an interferometer set-up in which two wavelengths are used simultaneously. This enables one to determine separately the phase shifts caused by changes in plasma density and by mechanical vibrations of the interferometer structure.

17802 (UCRL—85666) **FPPAC: a two-dimensional multispecies nonlinear Fokker-Planck package.** McCoy, M.G.; Mirin, A.A.; Killeen, J. (Lawrence Livermore National Lab., CA (USA)). Mar 1981. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01.

The complete nonlinear multispecies Fokker-Planck collision operator for a plasma in two-dimensional velocity space is solved. The operator is expressed in terms of spherical coordinates (v = speed, θ = angle between velocity and magnetic field directions, phi = azimuthal angle) under the assumption of azimuthal symmetry. Provision is made for additional physics contributions.

17803 **Nonlinear evolution of Buneman instability.** Ishihara, O.; Hirose, A.; Langdon, A.B. (Univ. of Saskatchewan, Saskatoon). Contract W-7405-ENG-48. *Physics of Fluids, The ;* **24**: No. 3, 452-464(Mar 1981).

The nonlinear evolution of one-dimensional electron-ion two-stream instability in a field-free plasma is studied both analytically and numerically (computer simulation). The instability is dominated by the fastest growing mode and its harmonics, provided

that the initial fluctuation level is sufficiently small. A nonlinear dispersion relation is derived and solved numerically, taking into account; (a) the frequency and growth rate modulation, (b) the electric field up to ϵ/sub k/^{4}, and (c) the renormalized particle distribution functions. The model can successfully explain the results of a computer simulation, particularly the presence of an algebraic growth stage following the breakdown of the exponential linear growth, the appearance of harmonics, and the final saturation level. The minimum conductivity found scales as (M/m)$^{0.61}$ ω/sub p/e, where M/m is the ion/electron mass ratio.

17804 **Theory of m = 1 modes in collisionless plasmas.** Basu, B.; Coppi, B. (Massachusetts Inst. of Tech., Cambridge, MA). *Physics of Fluids, The ;* **24**: No. 3, 465-471(Mar 1981).

Modes with azimuthal or poloidal wavenumber m = 1 can appear in the form of internal kinks that are described by the ideal magnetohydrodynamic approximation, or in the form of reconnecting modes that lead to the formation of magnetic islands. An analysis of these modes is developed for collisionless regimes, where the collisional electrical resistivity is negligible and the effects of finite ion inertia and mode-particle resonance play the most important role.

17805 **Nonlinear theory of high-m tearing modes.** Dominguez, R.R.; Rosenberg, M.; Chang, C.S. (General Atomic Co., San Diego, CA). Contract DE-ATO3-76ET51011. *Physics of Fluids, The ;* **24**: No. 3, 472-477(Mar 1981).

A simplified nonlinear theory of short wavelength (high-m) electron temperature-gradient-driven tearing modes is presented. Saturation of the linear instability results from nonlinear mode coupling in which energy may cascade to both short and long wavelength modes. The resulting electron thermal conductivity exhibits the density scaling and absolute magnitude observed experimentally.

17806 **Effect of resonance broadening on the evolution of the edge of a turbulent spectrum.** Kritz, A.H.; Fisch, N.J.; Karney, C.F.F. (Hunter Coll. of the City University of New York, NY). Contract DE-AC02-76-CH03073. *Physics of Fluids, The ;* **24**: No. 3, 504-508(Mar 1981).

The extent to which nonlinear wave-particle resonance broadening results in a narrowing of an incident lower-hybrid wave spectrum is investigated. This narrowing is of concern because it could make control of lower-hybrid heating difficult. It is shown numerically, however, that relatively uniform spatial power deposition occurs if resonance broadening effects are treated consistently on both the wave spectrum and the particle distribution.

17807 **Structure in the ion-acoustic spectrum.** Horton, W. Jr.; Brock, D. (Univ. of Texas, Austin). *Physics of Fluids, The ;* **24**: No. 3, 509-512(Mar 1981).

A mode simulation study using the renormalized turbulence theory for the current-driven ion-acoustic problem shows the presence of time-dependent structure in the wavenumber and frequency spectrum.

17808 **Toroidal plasma equilibrium with gravity.** Yoshikawa, S. (Princeton Univ., NJ). Contract DE-AC02-76-CH0-3073. *Physics of Fluids, The ;* **24**: No. 3, 513-516(Mar 1981).

A toroidal magnetic field configuration in a gravitational field is calculated both from a simple force-balance and by using magnetic surfaces. The configuration is found to be positionally stable in a star. The vibrational frequency near the equilibrium point is proportional to the hydrostatic frequency of a star multiplied by the ratio (W/sub B//W/sub m/)/sup 1/2/, where W/sub B/ is the magnetic field energy density, and W/sub m/ is the material pressure at the equilibrium point. It is proposed that this frequency may account for the observed solar spot cycles.

17809 **Statistical theory of magnetohydrodynamic turbulence.** Miller, G. (Los Alamos Scientific Lab., NM). *Physics of Fluids, The ;* **24**: No. 3, 560-561(Mar 1981).

The statistical approach to cylindrical magnetohydrodynamic turbulence of Montgomery, Turner, and Vahala is carried somewhat further. This leads to the general result that, in statistical equilibrium, the most probable value of the turbulently fluctuating magnetic field is force free.

17810 **Singular solutions and the continuous spectrum.** Hameiri, E. (Courant Institute of Mathematical Sciences, New York University, NY). Contract EY-76-C-02-3077. *Physics of Fluids, The ;* **24**: No. 3, 562-563(Mar 1981).

It is generally accepted that the continuous spectrum can be detected by the presence of nonsquare integrable solutions. This is shown to be incorrect as a general principle. A method to determine the singularity of eigenfunctions corresponding to the continuous spectrum is presented.

17811 **Constants of motion in a helical magnetic field.** Jones, R.D. (Los Alamos Scientific Lab., NM). *Physics of Fluids, The ;* **24**: No. 3, 564-565(Mar 1981).

The relationship between the screw symmetry of a helical magnetic field and the constants of motion of the system is obtained. In particular, the integral of motion for the symmetry is derived and the relationship between this integral and one obtained by Laird and Knox is demonstrated.

17812 **CW far-infrared laser-scattering apparatus for plasma wave studies.** Peebles, W.A.; Luhmann, N.C. Jr.; Mase, A.; Park, H.; Semet, A. (University of California, Los Angeles, California 90024). EY-76-C-03-0010,PA26. *Review of Scientific Instruments, The ;* **52**: No. 3, 360-370(Mar 1981).

A description of the design and construction of the first cw far-infrared laser-scattering apparatus for the study of the frequency and wavenumber spectra of plasma density fluctuations is given. Scattering results from both a controlled laboratory plasma and the UCLA Microtor tokamak are discussed.

17813 **Formation and propagation of a proton ring.** Dreike, P.L.; Greenly, J.B.; Hammer, D.A.; Sudan, R.N. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853). DE-AS02-77ET53005. *Physical Review Letters ;* **46**: No. 8, 539-542(23 Feb 1981).

A magnetically self-confined ring of 430-keV protons with a field reversal on axis of 3% is formed in an 8-kG solenoid, as evidenced by propagation more than 1 m in 15—400 mTorr air or hydrogen without dispersion. Up to 83% of the proton kinetic energy is in rotation and inductive coupling of axial ring energy to azimuthal plasma current induced in air (but not hydrogen) gives reflection of >50% of the ring from a 23% mirror.

17814 **Classical anomalous absorption in strongly magnetized plasmas and effective shielding length.** Matsuda, K. (General Atomic Co., San Diego, CA). Contract EY-76-C-03-0167. *Physical Review Letters ;* **46**: No. 7, 481-485(16 Feb 1981).

The high-frequency conductivity tensor of a plasma in a magnetic field has been evaluated. An anomalous perpendicular conductivity is obtained for a strongly magnetized plasma. Contrarily to the previous prediction, the effective shielding length is found to be the Debye length even when the Debye length is larger than the electron gyroradius. The effective shielding length is further discussed by presenting the generalized Balescu-Lenard equation.

17815 **Inverse ion diode experiment.** Miller, P.A.; Halbleib, J.A.; Poukey, J.W.; Verdeyen, J.T. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *Journal of Applied Physics ;* **52**: No. 2, 593-598(Feb 1981).

An experimental test has been performed of a novel ion diode intended for inertial confinement fusion applications. The diode is a small thin-walled evacuated glass sphere (nicknamed a "light bulb") which is irradiated by relativistic electron beams transported to the sphere via plasma channels. The virtual cathode formed by the electrons in the light bulb accelerates ions radially inwards from the walls of the sphere. The ions are focused on a levitated central target. Qualitative aspects of one-dimensional theoretical analyses of the light bulb are supported by the experimental results reported here. However, the overall ion beam generation ef-

ficiency in the experiment is evidently substantially below that of the simple theory, probably owing to two-dimensional effects.

17816 **Current generation by minority-species heating.** Fisch, N.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 1, 15-22(Jan 1981).

It is proposed that electric currents be generated from the preferential heating of ions travelling in one direction but with no net momentum injected into the system. This can be accomplished with, for example, travelling waves in a two-ion-species plasma. The current can be generated efficiently enough for the scheme to be of interest in maintaining steady-state toroidal currents in a reactor.

17817 **Effects of impurity radiation on reversed-field pinch evolution.** Caramana, E.J. (Los Alamos Scientific Lab., NM (USA)); Perkins, F.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 1, 23-39(Jan 1981).

A study is made of the effects of impurity radiation on the evolution of a reversed-field pinch plasma by means of a one-dimensional MHD simulation code that includes both plasma transport and impurity effects, and follows the plasma through a series of equilibrium states. Results are presented for the ZT-S, ZT-40, and RFX experiments with a fixed set of parameters, typical or envisioned, and various concentrations of impurities. Radiation barriers are encountered, and limits are found on the acceptable level of low-Z impurities that may be present in these devices. It is shown that the temperatures observed in the ZT-S experiment are radiation-limited. A criterion for radiation barrier burn-through is derived in terms of appropriate non-dimensional parameters and calibrated by comparison with the numerical simulations for the case of oxygen.

17818 **High-n ballooning modes in highly elongated tokamaks.** An, C.H. (Tennessee Univ., Knoxville (USA)); Bateman, G. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). *Nuclear Fusion ;* **21**: No. 1, 55-65(Jan 1981).

An analytic study of stability against high-n ballooning modes is highly elongated axisymmetric plasmas is presented and compared with computational results. - From the equation for the marginal pressure gradient, it is found that local shear has an important effect on the stability of elongated plasmas, and that stability deteriorates through high elongation since the stabilizing effects of field line bending and local shear are reduced. The net contribution of the local shear to stability decreases with elongation for strong ballooning modes (eigenfunctions strongly localized near the outer edge of the toroidal flux surfaces) but increases for interchange modes (eigenfunctions more uniform along the flux surfaces). - The computational study of high-n ballooning modes in a highly elongated plasma reveals that lowering the aspect ratio and broadening the pressure profile enhance the marginal beta for βsub(p) less than unity but severely reduce the marginal beta for βsub(p) larger than unity.

17819 **Fusion neutron production during deuterium neutral-beam injection into the PLT tokamak.** Strachan, J.D.; Colestock, P.L.; Davis, S.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 1, 67-81(Jan 1981).

Fusion neutron emission of 1.5×10^{14} neutrons.s^{-1} and 2×10^{13} neutrons/pulse has been observed for PLT deuterium discharges with up to 2.5 MW of deuterium neutral-beam injection. The neutron time evolution and magnitude are consistent with theoretical calculations of the fusion reactions caused by energetic injected ions which are confined and slow down classically. The factor-of-two accuracy in the absolute neutron calibration is the major uncertainty in the comparison with theory. Neutron sawtooth oscillations (approximately $<3\%$) are observed which can also be explained classically.

17820 **Tandem-mirror sloshing-electron plugs.** Kesner, J. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering; Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Nuclear Fusion ;* **21**: No. 1, 97-100(Jan 1981).

By a proper usage of ECRH heating in minimum-B tandem mirror plugs, thermal barriers can be created which thermally insulate hot-plug electrons from both the central cell and the outside environment. This arrangement can be utilized in an axisymmetric, outboard anchor plug arrangement or a minimum-B plug. In the axisymmetric arrangement, ICRF can serve as a pump for preventing ions from accumulating in the thermal-barrier potential depression whereas, in the minimum-B plug, unconfined drift orbits should prevent such an accumulation.

17821 **Current-driven resistive drift instabilities in sheared magnetic fields.** De Vore, C.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion ;* **21**: No. 1, 105-109(Jan 1981).

The de-stabilizing influence of an equilibrium parallel (to B vector) current on drift waves in a collisional, sheared slab plasma is investigated. Absolute instability occurs only for currents substantially in excess of those present in most tokamak experiments. Fluctuations in the electron temperature are retained and are found to be essential to the analysis of the current-driven mode.

17822 **Passive thermal-stability control in ignited tokamaks by ripple transport and radial motion.** Bromberg, L.; Cohn, D.R. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). *Nuclear Fusion ;* **21**: No. 1, 110-113(Jan 1981).

A methodology is developed to study the use of the combination of ripple-induced ion conduction loss and radial motion for passive thermal stability control of an ignited tokamak plasma. Radial fluctuations are coupled to temperature fluctuations by MHD equilibrium requirements. A 0-dimensional model with parabolic profiles is employed. Illustrative calculations are made for tokamak plasmas where the electron energy confinement time is described by the empirical scaling law tausub(e) approximately na^2. The ripple-induced thermal conduction is modelled by the addition of an ion energy loss channel to a plasma described by neoclassical ion energy transport; this additional ion loss channel is represented by an energy confinement time scaling tausub(i,ripple) approximately Tsub(i)sup(-epsilon), where Tsub(i) is the ion temperature and epsilon is a variable parameter. The amount of additional ion power loss required for the achievement of thermal stability is determined. The corresponding increase in the value of ntausub(e) required for ignition is computed. The combined effects of radial motion and a ripple-induced transport loss with tausub(i,ripple) approximately Tsub(i)sup(-7/2), as might be the case for ripple trapping, can be used to obtain thermal stability for central ion temperatures higher than 20 keV with a very small ($<2\%$) additional power loss by ripple transport; this loss could be provided by peak-to-average ripple at the boundary of approximately 1%.

17823 **Global method of solving the electron-field equations in a zero-inertia-electron-hybrid plasma simulation code.** Hewett, D.W. (Los Alamos Scientific Lab., NM). Contract W-7405-ENG-36. *Journal of Computational Physics ;* **38**: No. 3, 378-405(Dec 1980).

A formulation of the electron momentum equation and Maxwell's field equations suitable for global solution in an r-z hybrid plasma simulation code has been derived. The assumption of zero electron inertia is made in the electron momentum equation and Maxwell's equations are used in the radiation-free or Darwin limit. These techniques make explicit use of the axisymmetric properties of the model to decouple the components of the model equations. Equations to self-consistently advance the electron temperature are not presently included in this scheme. The model equations which result from these considerations are two coupled, nonlinear, second order partial differential equations. These two equations are integrated in time by a noniterative ADI procedure along with the explicit particle-in-cell ion time integration procedure. The resulting nearly implicit electron-field algorithm treats wide variations in the local signal velocity without instability; this consideration is most important since pure vacuum regions are allowed. The global nature of the solution requires boundary conditions only on the boundaries of the simulation region; arbitrary intermixing of plasma vacuum regions requires only the simple detection of low density cells and does not require monitoring of plasma vacuum interfaces.

17824 Dynamic and quasi-equilibrium Lagrangian MHD in 1-D. Oliphant, T.A. Contract W-7405-ENG-36. *Journal of Computational Physics ;* 38: No. 3, 406-412(Dec 1980).

Iterative calculations are presented for an ideal equilibrium z-pinch.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 17084, 17108, 17115, 17220, 17274, 17460, 17592, 17683, 17690, 17704, 17707, 17780

17825 Stabilization of toroidal plasma devices. Ohkawa, T. (to General Atomic Co., San Diego, CA (USA)). Australian Patent 80/54,555/A/. 7 Aug 1980. vp.

A plasma device is claimed. It comprises a confinement vessel, a means for producing plasma current within the vessel, windings helically wound around the vessel and equally spaced around the axis of the vessel and a second group of windings helically wound around the vessel midway between successive first windings. A helical magnetic field is generated by passing a direct current through the first windings and passing a second direct current through the second windings in the direction counter to the first current.

17826 (ANL/FPP/TM—141) Wave-driver options for low-aspect-ratio steady-state tokamak reactors. Ehst, D.A. (Argonne National Lab., IL (USA)). Feb 1981. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01.

Low aspect ratio designs are proposed for steady-state tokamak reactors. Benefits stem from reduced major radius and lessened stresses in the toroidal field coils, resulting in possible cost savings in the tokamak construction. In addition, a low aspect ratio (A = 2.6) permits the application of a bundle divertor capable of diverting 3-T fields to a power reactor using STARFIRE technology. Such a low aspect ratio is possible with the elimination of poloidal field coils in the central hole of the tokamak, which implies a need for noninductive current drive. Several plasma waves are considered for this application, and it appears likely that a candidate can be found which reduces the electric power for current maintenance to an acceptable value.

17827 (BNL—29159) Development of multiampere negative ion sources. Alessi, J.; Hershcovitch, A.; Prelec, K.; Sluyters, T. (Brookhaven National Lab., Upton, NY (USA)). 1981. Contract AC02-76CH00016. 3p. (CONF-810314—73). NTIS, PC A02/MF A01.

From Particle accelerator conference; Washington, DC, USA (11 Mar 1981).

The Neutral Beam Development Group at BNL is developing H-/D- surface plasma sources as part of a high energy neutral beam injector. Uncooled Penning and magnetron sources have operated at a maximum beam current of 1 A (10 ms pulses, Mk III) and a maximum pulse length of 200 ms (0.3 A, Mk IV). A magnetron source with focusing grooves on the cathode and an asymmetric anode-cathode geometry operates at a power efficiency of 8 kW/A and a 6% gas efficiency. As the next step, a water cooled magnetron, designed to give a steady state beam of 1 to 2 A, has been constructed. Experiments are in progress to test a modification of the magnetron which may significantly improve its performance. By injecting a sheet of plasma, produced by a highly gas efficient hollow cathode discharge, into a magnetron type anode-cathode geometry, we anticipate a reduction of the source operating pressure by at least three orders of magnitude. Initial experiments have given indications of H^- production. The next plasma injection experiment is designed to give a steady state beam of $\simeq$ 1 A.

17828 (BNL—29190) Design studies of an aluminum first wall for INTOR. Powell, J.R.; Fillo, J.A.; Yu, W.S.; Hsieh, S.Y.; Pearlman, H.; Kramer, R.; Franz, E.; Craig, A.; Farrell, K. (Brookhaven National Lab., Upton, NY (USA); Rockwell International Corp., Canoga Park, CA (USA); Aluminum Co. of America, Alcoa Center, PA; Oak Ridge National Lab., TN (USA)). 1980. Contract AC02-76CH00016. 8p. (CONF-801011—82). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Besides the high erosion rates (including evaporation) expected for INTOR, there may also be high heat fluxes to the first wall, e.g., $\sim$ 9 (Case I) to 24 (Case II) W/cm^2, from two sources - radiation and charge exchange neutrals. There will also be internal heat generation by neutron and gamma deposition. An aluminum first wall design is analyzed, which substantially reduces concerns about survivability of the first wall during INTOR's operating life.

17829 (CONF-801210—24) Applications of fusion thermal energy to industrial processes. Bowman, R.M.; Jody, B.J.; Lu, K.C. (Institute of Gas Technology, Chicago, IL (USA)). 1980. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The feasibility of applying fusion thermal energy as process heat in the iron-steel industry, petrochemical industry, cement industry, and in the production of acetylene fom coal via calcium carbide are discussed. These four industries were selected for analysis because they require massive amounts of energy. This preliminary study concludes that the production of synthetic fuels using fusion heat appears to be the most promising method of storing and transporting this heat. Of the four industries studied, the iron-steel and the petrochemical industries appear to be the most promising because they consume substantial amounts of hydrogen and oxygen as feedstocks. These can be produced from water using the high-temperature fusion heat. The production of hydrogen and oxygen using fusion heat will also reduce the capital investment required for these industries. These two industries also consume tremendous amounts of heat at temperatures which can be delivered from a fusion blanket via chemical heat pipes.

17830 (DOE/DP/40109—2) Light ion fusion experiment (L.I.F.E.) concept validation studies. Final report, July 1979-May 1980. Christensen, T.E.; Orthel, J.L.; Thomson, J.J. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Dec 1980. Contract AC08-79DP40109. 23p. (TRW—33876-7). NTIS, PC A02/MF A01.

This report reflects the considerable advances made for the objectives of the contractual program, validating by detailed anaytical studies the concept of a new Light Ion Fusion Experiment for Inertial Confinement Fusion. The studies have produced an analytical design of a novel electrostatic accelerator based on separate function and strong channel focusing principles, to launch 3 to 10 MeV, 23 kA, He^+ neutralized beams in 400 ns pulses, delivering on a 5 mm radius target located 10 m downstream, 50 kJ of implosion energy in $\sim$ 20 ns impact times The control, stability and focusing of beams is made by electrostatic quadrupoles, producing overall beam normalized emittance of $\sim 3 \times 10^{-5}$ m-rad.

17831 Testing of low-Z-coated limiters in tokamak fusion devices. Whitley, J.B.; Mullendore, A.W. (Sandia Labs., Albuquerque, NM (USA)); Langley, R.A. (Oak Ridge National Lab., TN (USA)). *Thin Solid Films ;* 73: No. 1, 81-90(3 Nov 1980).

From International conference on metallurgical coatings; San Diego, CA, USA (21 - 25 Apr 1980).

Coatings of materials with low atomic number Z are being developed for application both in experimental tokamak devices such as ISX and TFTR and for possible use on various components of large power-producing controlled thermonuclear reactors. A suitable coating has the potential of improving the plasma energy balance by lowering the atomic number of the impurities injected by plasma-wall interactions. This results in a decrease in plasma radiation losses and improved plasma stability. The coatings will be subjected to a severe environment and must be able to withstand physical erosion, chemical erosion, thermal shock, thermal fatigue and arcing without rapid degradation or loss of adhesion. Extensive testing on a laboratory scale was used to select the coatings most suitable for this environment. From this testing, which included pulsed electron beam heating, low energy ion bombardment and arcing, chemically vapor-deposited coatings of TiB_2 and TiC on Poco graphite substrates were selected and tested as limiters in ISX. Both limiter materials gave clean stable reproducible tokamak discharges on the first day of operation. After an exposure of 1

week, the TiC limiter showed only superficial damage with no coating failure. The TiB_2 limiter showed some small areas of coating failure. TiC-coated graphite limiters were also briefly tested in the tokamaks Alcator and PDX with favourable results.

17832 **(DOE/ER/10107—1) Alloy development for irradiation performance in fusion reactors. Annual report, September 1979-September 1980.** Harling, O.K.; Grant, N.J. (Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.). Dec 1980. Contract AS02-78ER10107. 118p. NTIS, PC A06/MF A01.

This report summarizes the research and development work performed during the second year of an M.I.T. project directed toward the development of improved structural alloys for the fusion reactor first wall application. Several new alloys have been produced by rapid solidification. Emphasis in alloy design and production has been placed on producing austenitic Type 316SS with fine dispersions of TiC and Al_2O_3 particles. Results of mechanical and microstructural tests are presented. A number of neutron irradiations have been initiated on samples fabricated from alloys produced in this project. A dual beam, heavy ion and helium ion, irradiation was completed using several alloys and a range of temperatures, damage rates and total doses. Modeling of irradiation phenomena has been continued with emphasis in the last year upon understanding the effect of recoil resolution on relatively stable second phase particles. Work continued to fully characterize the microstructure of several ZrB_2 doped stainless steels.

17833 **(DOE/ET/51010—9) Feasibility of recycling thorium in a fusion-fission hybrid/PWR symbiotic system.** Josephs, J.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). 31 Dec 1980. Contract AC02-77ET51010. 54p. NTIS, PC A04/MF A01.

A study was made of the economic impact of high levels of radioactivity in the thorium fuel cycle. The sources of this radioactivity and means of calculating the radioactive levels at various stages in the fuel cycle are discussed and estimates of expected levels are given. The feasibility of various methods of recycling thorium is discussed. These methods include direct recycle, recycle after storage for 14 years to allow radioactivity to decrease, shortening irradiation times to limit radioactivity build up, and the use of the window in time immediately after reprocessing where radioactivity levels are diminished. An economic comparison is made for the first two methods together with the throwaway option where thorium is not recycled using a mass energy flow model developed for a CTHR (Commercial Tokamak Hybrid Reactor), a fusion fission hybrid reactor which serves as fuel producer for several PWR reactors. The storage option is found to be most favorable; however, even this option represents a significant economic impact due to radioactivity of 0.074 mills/kW-h which amounts to $4 x 10^9 over a 30 year period assuming a 200 gigawatt supply of electrical power.

17834 **(DOE/TIC—11435(Vol.1)) Laser fusion systems for industrial process heat. Final report.** Bates, F.J.; Denning, R.S.; Dykhuizen, R.C.; Goldthwaite, W.H.; Hall, E.H.; Kok, K.D.; Skelton, J.C.; Walters, C.T. (Battelle Columbus Labs., OH (USA)). Jun 1979. Contract W-7405-ENG-92-096. 41p. NTIS, PC A03/MF A01.

The following topics are discussed in this report: (1) industrial process heat requirements, (2) identification and prioritization of industrial criteria for selection of an energy system, (3) development of conceptual energy station designs, and (4) economics of alternative energy sources. (MOW)

17835 **(DOE/TIC—11435(Vol.2)) Laser fusion systems for industrial process heat. Final report.** Bates, F.J.; Denning, R.S.; Dykhuizen, R.C.; Goldthwaite, W.H.; Hall, E.H.; Kok, K.D.; Skelton, J.C.; Walters, C.T. (Battelle Columbus Labs., OH (USA)). Jun 1979. Contract W-7405-ENG-92-096. 123p. NTIS, PC A06/MF A01.

This volume contains the detailed technical data developed during the study and describes the models used to calculate and develop the detailed technical data. Thus the reader can obtain a basic understanding of the study and its results by reading Volume I while the person interested in the technical data and methods used to develop the conclusions will want to review Volume II.

17836 **(EGG-PHYS—5392) Physics calculations for preliminary feasibility studies of fusion blanket testing in ETR.** Wessol, D.E.; Judd, J.L.; Millsap, D.A.; Scott, A.J.; Miller, L.G.; Longhurst, G.R.; Hsu, P.Y. (Idaho National Engineering Lab., Idaho Falls (USA)). Mar 1981. Contract AC07-76ID01570. 31p. NTIS, PC A03/MF A01.

Testing fusion components in a fission reactor would provide a timely and workable approach to finding solutions to some of the engineering problems which must be solved before the next generation of fusion reactors can be built and operated. Hypothetical irradiations of three fusion first wall/blanket systems in the Engineering Test Reactor (ETR) are analyzed. The ability of reproducing, in a fission environment, the bulk heating spatial profiles anticipated in a fusion environment is demonstrated.

17837 **(GA-A—16098) Magnetic fusion energy program. Summary progress report, October 1, 1978-September 30, 1979.** (General Atomic Co., San Diego, CA (USA)). Dec 1980. Contract AT03-76ET51011. 554p. NTIS, PC A23/MF A01.

The progress of research and experimentation carried out at General Atomic Company with the support of the United States Department of Energy and directed at developing magnetic fusion is reviewed for the period from 1 October 1978 through 30 September 1979. The report covers progress in physics experiments conducted in Doublet IIA and Doublet III and also (in a cooperative program with Oak Ridge National Laboratory) on ISX-B. Also covered are new developments in plasma magnetohydrodynamic and kinetic theory, advances in the configuration and operation of the User Service Center of the National Magnetic Fusion Energy Computer Center Network, the development of new plasma instrumentation, and studies of possible future fusion reactor materials and components as well as overall configurations for future reactors.

17838 **(ORNL/TM—7691) Ion extraction and optics in three dimensions.** Wooten, J.W.; McCollough, D.H.; McGaffey, R.W.; Drooks, L.J.; Whealton, J.H.; Akin, J.E. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 37p. NTIS, PC A03/MF A01.

An algorithm is described for a solution to the three-dimensional (3-D) Poisson-Vlasov equations for ions extracted from a plasma. A variational formulation of Poisson's equation using isoparametric finite elements leads to a band matrix, which is solved by a modified Gauss-Cholesky method. A semi-implicit method is described for the inclusion of nonlinear plasma electrons, allowing an explicit solution of the extraction sheath. An intrinsically 3-D example is shown.

17839 **(ORNL/TM—7758) Neutronic calculations for the conceptual design of an in-reactor solid breeder experiment, TRIO-01.** Childs, R.L.; Gabriel, T.A.; Lillie, R.A. (Oak Ridge National Lab., TN (USA)). Mar 1981. Contract W-7405-ENG-26. 23p. NTIS, PC A02/MF A01.

Neutronics calculations have been performed to obtain tritium production and heat generation rates for the irradiation of solid tritium breeding materials in the Oak Ridge Research Reactor (ORR). Two breeder materials, Li_2O and $LiAlO_2$, were considered. Burnup calculations were performed to estimate the amount of ^6Li present as a function of time.

17840 **(PNL—3685) Analysis of regulatory structure for a potential fusion-reactor industry.** (Donovan, Hamester and Rattien, Inc., Washington, DC (USA)). Mar 1981. Contract AC06-76RL01830. 95p. NTIS, PC A05/MF A01.

The report is divided into eight sections. The preface describes the authors of the report, the methodology used in its preparation, and some basic legal terms. The summary describes the principal features of the proposed regulatory system and also includes two flow charts comparing our model with present NRC practices and a summary table briefly outlining the reasoning behind our recommendations. The main body of the report is divided into six sections. This part of the report discusses the existing federal and state programs for regulating electric energy, describes NRC operations and the criticisms of that agency, discusses the features of our pro-

posed regulatory model, recommends certain steps for implementing the proposed model, and states the conclusions of the report.

17841 **(PPPL—1755) Proceedings of the US-Japan joint symposium on compact toruses and energetic particle injection.** (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1981. Contract AM02-76CH03073. 250p. (CONF-791225—). NTIS, PC A11/MF A01.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Separate abstracts were prepared for 59 of the included papers. (MOW)

17842 (PPPL—1755, pp 3-7) **Compact torus concept and the spheromak.** Furth, H.P. (Princeton Univ., NJ). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The present paper is concerned mainly with a brief review of the case rho/sub pol/ < a/sub plasma/, where the current carriers have poloidal-field gyroradii that are smaller than the scale height of the plasma.

17843 (PPPL—1755, pp 12-15) **LASL Compact Torus Program.** Linford, R.K.; Armstrong, W.T.; Bartsch, R.R. (Los Alamos Scientific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The Compact Torus (CT) concept includes any axisymmetric toroidal plasma configuration, which does not require the linking of any material through the hole in the torus. Thus, the magnet coils, vacuum vessel, etc., have a simple cylindrical or spherical geometry instead of the toroidal geometry required for Tokamaks and RFP's. This simplified geometry results in substantial engineering advantages in CT reactor embodiments while retaining the good confinement properties afforded by an axisymmetric toroidal plasma-field geometry. CT's can be classified into three major types by using the ion gyro radius rho/sub i/ and the magnitude of the maximum toroidal field B/sub tm/.

17844 (PPPL—1755, pp 8-11) **Injection of relativistic electron beam into toroidal systems.** Mohri, A.; Narihara, K.; Tomita, Y. (Nagoya Univ., Japan). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In recent years, the injection of high current relativistic electron beams into toroidal systems has been a subject of absorbing interest in connection with compact torus and OH assist startup for large tokamak. Injection methods tried up to the present are surveyed here and a method using Plasma Anode, which is adopted for REB injection into SPAC, is reviewed.

17845 (PPPL—1755, pp 16-19) **Initial results of field reversed plasma gun experiment.** Turner, W.C. (Lawrence Livermore National Lab., CA); Hartman, C.W.; Taska, J.; Smith, A.C. Jr. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

We have begun experiments using a magnetized co-axial plasma gun to produce field reversed plasma. The gun injects axially into the Beta II facility at Livermore. The experimental program consists of three stages: (1) formation, (2) translation and magnetic mirror trapping and (3) neutral beam heating of field reversed plasma. Experiments to date pertain to the first stage and have demonstrated production of field reversed plasma.

17846 (PPPL—1755, pp 26-28) **Intense relativistic electron beams in toroidal magnetic geometries.** Bailey, V.; Benford, J.; Cooper, R.; Ecker, B.; Helava, H. (Physics International Co., San Leandro, CA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

17847 (PPPL—1755, pp 29-32) **Compact torus research at UCI.** Fisher, A.; Robertson, S.; Rostoker, N. (Univ. of California, Irvine). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Compact torus research at UCI consists of several experimental and theoretical programs involving intense electron and ion beams, field-reversed mirrors, and toroidal confinement systems. These programs are based upon an earlier program of research into field reversal and heating with intense electron beams.

17848 (PPPL—1755, pp 33-36) **LONGSHOT injector: a 3/4 kJ, 120 keV pulsed source of 3 x 10^{16} ions for ion ring formation.** Greenly, J.B.; Hammer, D.A.; Sudan, R.N. (Cornell Univ., Ithaca, NY). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A new long pulse intense ion beam source, LONGSHOT, based on the Pulselac injector built at Sandia Laboratories, is being developed. The present Longshot injector produces 5 mcoul at 100 to 150 keV (0.5 to 0.75 kJ) of ions in a 600 nsec pulse, with a pulse power generator considerably smaller than either the IREX or NRL experiment, and this long-pulse beam propagates well across a strong cusp in vacuum, without injection of neutral gas or provision of any active electron sources by charge neutralization.

17849 (PPPL—1755, pp 37-40) **Reversed-field configuration with rotating relativistic electron beams.** Sethian, J.D.; Gerber, K.A.; Spector, D.N.; Robson, A.E. (Naval Research Lab., Washington, DC). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The use of rotating relativistic electron beams to produce a field reversed configuration was first proposed by Christofilos. In his Astron concept, the field-reversing currents were provided by the relativistic electrons. This paper describes a different method of achieving a reversed field geometry, in which the beam has been used to induce plasma currents, in originally neutral hydrogen gas, which then maintain the fields long afte the beam has left the system. Because the beam has both azimuthal and axial components, both axial (poloidal) and aximuthal (toroidal) fields are induced, and thus the configuration can be topologically similar to a Compact Toroid.

17850 (PPPL—1755, pp 41-44) **Results and present status of the relativistic electron ring experiments and their application to Spheromak problems.** Fleischmann, H.H. (Cornell Univ., Ithaca, NY). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The results and present status of the Cornell RECE program on field-reversing electron rings are summarized in particular with regard to potential applications of these results to other Compact Toroid concepts. Since its initiation in the early 70's, this program is aimed mainly at testing various physics questions related to the use of field-plasma.

17851 (PPPL—1755, pp 45-48) **Reversed field configurations generated by proton pulses.** Pasour, J.A.; Golden, J.; Marsh, J.; Kapetanakos, C.A. (Naval Research Lab., Washington, DC). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Magnetic field configurations with closed field lines generated by energetic ion rings or layers have the advantage that the gyrating particles of the ring serve as an internal energy source for heating the confined plasma. The objective of the Ion Ring Program at NRL is to test the feasibility of forming strong ion rings that reverse the applied magnetic field by trapping about 10^{17} protons of 1 to 2 MeV energy inside a magnetic mirror.

17852 (PPPL—1755, pp 61-64) **Reconnection conditions for flowing field-reversed plasma from a plasma gun.** Shearer, J.W.; Eddleman, J.L.; Ferguson, J.R. (Lawrence Livermore Lab., CA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Although various theoretical models are known for magnetic reconnection, none of them are applicable to the BETA-II experiment because they do not model the plasma flow conditions. The

coaxial gun produces a plasma stream with an axial velocity of ~ 10^8 cm/sec. In the plasma rest frame an aperture or snipper coil would appear to move in the opposite direction at this same velocity. A more suitable model for the BETA-II reconnection problem was formulated based on the equations of fluid flow through a nozzle.

17853 (PPPL—1755, pp 65-67) **Physics of the OHTE.** Ohkawa, T. (General Atomic Co., San Diego, CA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

It is commonly known that stable toroidal magnetic plasma confinement requires both poloidal and toroidal magnetic fields. In axisymmetric confinement, the poloidal field is generated by toroidally directed plasma currents, while the toroidal field is supplied by external coils (tokamak), plasma paramagnetism (spheromak), or a combination of the two (reversed-field pinch). It is possible to provide a net toroidal field by translational tranform through the combination of a helical field with a predominantly poloidal field ($q<<1$), such as that of a paramagnetic pinch, and this is the basis of OHTE confinement. The similarities and differences among these toroidal systems are illustrated.

17854 (PPPL—1755, pp 72-75) **Particle-fluid hybrid simulation of field reversal in a mirror plasma.** Cohen, B.I.; Brengle, T.A. (Lawrence Livermore Lab., CA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A one-dimensional, cylindrically symmetric hybrid simulation code has been developed to investigate field reversal in a mirror plasma. The fluid momentum equation is used to determine the electron current density with n/sub e/m/sub e/dv vector/sub e//dt = O and n/sub e/ ≃ n/sub i/. Large-orbit ions are followed by integrating particle equations of motion. Momentum-conserving electron-ion drag is included.

17855 (PPPL—1755, pp 80-81) **Steady state beam driven field-reversed mirror.** Hammer, J.H.; Berk, H.L. (Univ. of California, Livermore). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A method is presented for sustaining a current in a beam driven field reversed mirror. It has been shown that attempts to drive steady state field reversed configurations (or Tokamaks, Spheromaks) with neutral beams may be foiled by electron currents. The plasma electrons are accelerated by collisional interaction with the beam-produced ion current, causing the net current to vanish asymptotically in time. We show that the current cancellation can be avoided by weakly breaking the toroidal symmetry of the device, for instance by the addition of quadrupole magnetic fields. The symmetry breaking allows angular momentum transfer between the electrons and the external coil structures, without having plasma in contact with material surfaces.

17856 (PPPL—1755, pp 86-88) **Toroidal reversed field-pinch experiments.** Baker, D.A. (comp.). (Los Alamos Scientific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

This brief review covers several small experiments plus the ETA BETA II and 2T-40 experiments. (MOW)

17857 (PPPL—1755, pp 118-121) **Two-dimensional compression in general compact tori.** Hameiri, E.; Grossmann, W. (New York Univ., NY). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In this work we generalize the adiabatic compression code of H. Grad to include the effects of rotation. The situation envisioned is a compression process much slower than acoustical transit times across the major dimensions of the plasma. The plasma waves then cause fast equilibration and on the compression time scale the plasma is seen as creeping from one equilibrium state to the next. The different states are related to each other by maintaining constants of the motion of the exact dynamical system, namely: the magnetic flux and the mass and angular momentum within each flux tube. The compression itself is created either by increasing the magnetic flux in the vacuum region, or by moving the external wall to a new radial position (to simulate the liner experiment).

17858 (PPPL—1755, pp 139-142) **Spheromak formation by theta pinch.** Nogi, Y.; Ogura, H.; Osani, Y.; Saito, K.; Shiina, S.; Yoshimura, H. (Nihon Univ., Tokyo, Japan). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Spheromak configuration is formed by using a theta pinch combined with a z-discharge. Toroidal field is generated by the z-current flowing in the plasma and the reverse current on its surface. The reverse mechanism is investigated here by the analysis of z-discharge circuit including the plasma. It is easy to reverse 70% of z-current on the plasma surface by using a very low external inductance circuit.

17859 (PPPL—1755, pp 143-146) **Field-reversed gun based on the inverse-pinch discharge.** Getty, W.D. (Univ. of Michigan, Ann Arbor). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The inverse-pinch discharge has a proven magnetic-field configuration with stability and geometric properties that make it attractive for generating a reversed-field plasma. A high-β plasma cylinder or ring can be generated with frozen-in poloidal and toroidal magnetic field components. The inverse-pinch discharge is theoretically MHD stable and has shown superior stability properties in experiments. By choice of the aspect ratio, one can produce tokamak- or belt-pinch-like geometries. In the latter case one could use azimuthal coils to force reconnection of field lines and axially compress the plasma.

17860 (PPPL—1755, pp 147-150) **Triggered-reconnection compact toroid experiment.** Hoffman, A.L.; Vlases, G.C. (Mathematical Sciences Northwest, Inc., Bellevue, WA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A schematic of the MSNW experimental apparatus, which is closely patterned after the Soviet experiment, is shown. A bias field is created by an external quasi-steady solenoid. An additional quasi-steady coil at each end is used to apply a mirror or cusp field configuration. Eight pairs of oppositely directed longitudinal conductors are located as shown to form a pulsed octopole field near the tube wall. In addition, at each end there is a very fast pulsed mirror trigger coil used to force reconnection at the desired time.

17861 (PPPL—1755, pp 155-158) **Stellarmak a hybrid Stellarator: Spheromak.** Hartman, C.W. (Univ. of California, Livermore). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

This paper discusses hybridization of modified Stellarator-like transform windings (T-windings) with a Spheromak or Field-Reversed-Mirror configuration. This configuration-Stellarmak-retains the important topological advantage of the Spheromak or FRM of having no plasma linking conductors or blankets. The T-windings provide rotational tranformation in toroidal angle of the outer poloidal field lines, in effect creating a reversed B/sub Toroidal/ Spheromak or adding average B/sub T/ to the FRM producing higher shear, increased limiting β, and possibly greater stability to kinks and tilt. The presence of field ripple in the toroidal direction may be sufficient to inhibit cancellation of directed ion current by electron drag to allow steady state operation with the toroidal as well as poloidal current maintained by neutral beams.

17862 (PPPL—1755, pp 159-161) **Utilization of electron coils for an advanced Tokamak and conjecture about the cause for current step (down).** Yoshikawa, S. (Princeton Univ., NJ). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

17863 (PPPL—1755, pp 162-165) **Dynamically formed spheromak plasma (PS-1).** Goldenbaum, G.C.; Chong, Y.P.; Hart, G.; Irby, J.H. (Univ. of Maryland, College Park). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In this paper we discuss our recently reported observations of the formation of a highly elongated spheromak configuration. In the present context, we define a spheromak as a toroidal configurtion with both toroidal and poloidal field components, but with no toroidal field coils and no transformer. The toroidal field vanishes on the symmetry axis and has a maximum near the magnetic axis. Both the toroidaland poloidal fields have approximately equal maximum values. Our experiment is called Paramagnetic Spheromak (PS-1).

17864 (PPPL—1755, pp 166-170) **Spheromak equilibrium and stability and numerical studies of a spheromak formation scheme.** Okabayashi, M. (Princeton, NJ); Jardin, S.; Okuda, H.; Sato, T.; Sheffield, G.; Todd, A. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

17865 (PPPL—1755, pp 171-175) **Design and fabrication of the S-1 spheromak device.** Yamada, M. (Princeton Univ., NJ); Sinnis, J.; Furth, H.P.; Okabayashi, M.; Sheffield, G.; Stix, T.H.; Todd, A.M.M. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The S-1 experiment will develop an electrodless slow spheromak formation technique to produce a 500 kA toroid of a = 25 cm, R = 40 cm. The formation scheme is based on a transformation of poloidal and toroidal magnetic flux into a plasma from a flux core and two-dimensional MHD calculations of the formation process are described in an accompanying paper. Physics background and engineering aspects of the S-1 apparatus are presented. The objectives of the S-1 experiment are: (1) development of a slow quasi-static formation scheme, suitable for future scale-up to large magnetic energy contents at moderate forming powers and (2) investigation of spheromak stability and energy confinement properties on a slow time scale of magnetic diffusion time.

17866 (PPPL—1755, pp 176-179) **Two-dimensional simulation of the formation of the PPPL spheromak.** Aydemir, A.; Chu, C.K.; Lui, H.C. (Columbia Univ., New York, NY). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

This paper is a progress report on the simulation of the formation of the PPPL spheromak with a dissipative MHD calculation. We present the precise formulation of the problem, emphasizing particularly the time-dependent boundary conditions. We also present some very preliminary results, which are by no means complete or conclusive, but which do indicate that the general trend is correct and that this model has the basic capability to make a realistic simulation.

17867 (PPPL—1755, pp 180-183) **Bifurcation of toroidal plasma in a poloidal quadrupole field.** Ikezi, H.; Schwarzenegger, K.F. (Bell Labs., Murray Hill, NJ). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

We have studied the effect of a poloidal quadrupole field on the elongation and bifurcation of a current-carrying toroidal plasma. The experiment was carried out by using an argon discharge in a small tokamak with the toroidal field B/sub t/ = 2 to 5KG, the major radius R_0 = 11cm, the plasma current I/sub p/ = 2 to5 KA, T/sub i/ ≃ T/sub e/ ≃ 10eV, and n = (5 to 10) x 10^{13}/cc.

17868 (PPPL—1755, pp 184-185) **Start-up scenario of compact tori based on REB-injection developed in SPAC-group.** Ikuta, K. (Inst. of Plasma Plastics, Nagoya, Japan). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Quasi-static start-up of compact tori without toroidal field coil is reviewed thoroughly in a proposal of the S-1 spheromak. During the formation phase we should note that the rapid heat loss from the plasma will give a bad effect for the generation of the confinement configuration. In the case of fast start-up of the configuration plasma can safely pass over the dangerous state of the instability toward the desirable stable state with a bonus of producing hot plasma. By this reason it is intended to discuss a fast start-up scenario of the compact tori based on REB injection developed in SPAC group.

17869 (PPPL—1755, pp 186-188) **SPS compact torus experiment.** DeSilva, A. (Univ. of Maryland, College Park). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Balancing the apparent advantages of the spheromak configuration as a potential reactor are the difficulties in creating such a configuration in the first place. In particular, creating a toroidal field without material conductors threading the torus is a nontrivial exercise. We propose here a scheme that utilizes an intermediate energy storage within the plasma in the form of ordered kinetic energy, that may be released to drive poloidal currents and thereby create a toroidal magnetic field. The scheme is seen as a means of obtaining, in a short time, a spheromak configuration isolated from external current sources, for study of basic stability properties.

17870 (PPPL—1755, pp 189-192) **Minimum energy equilibria.** Reiman, A.; Sudan, R.N. (Cornell Univ., Ithaca, NY). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Taylor's theory of the relaxation of toroidal plasma discharges has accounted remarkably well for the experimentally observed behavior of toroidal z-pinches. His analysis also leads to particularly stable magnetic configurations which have served as the starting point for work on the speromak. We present here a corrected version of Taylor's analysis, including a term improperly left out of his expression for the energy of a force-free state. We also present force-free equilibrium solutions in cusp and higher order multipole external fields. These are to serve as the starting point for a study of modified spheromak configurations having improved magnetic field line curvature.

17871 (PPPL—1755, pp 200-203) **Field-reversed configurations: theoretical considerations and reactor applications.** Miley, G.H. (Univ. of Illinois, Urbana). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Some general considerations for reactor concepts are given. A review of four illustrative examples of compact torus reactor concepts is presented: (1) SAFFIRE; a quasi-steady state FRM, (2) spheromak moving plasmoid reactor, (3) compact reversed-field pinch, and (4) reversed-field theta pinch moving plasmoid heater concept. (MOW)

17872 (PPPL—1755, pp 204-207) **Holomak: a toroidal spheromak.** Stix, T.H.; Todd, A.M.M. (Princeton Univ., NJ). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Recent spheromak stability analysis favors a profile of plasma current concentrated in the toroidal core of the spheromak, with very low current density (and correspondingly low temperatures) in the region immediately about the major axis. Considering a toroidal (rather than spheroidal) spheromak therefore produces little change in the physics, but the existence of a permanently accessible central hole introduces major options in the reactor engineering. The holomak geometry (from holos, Greek: whole, safe), a low-absolute value q toroidal pinch, is described.

17873 (PPPL—1755, pp 208-211) **Linus reactor: compression of a compact torus by a liquid metal liner.** Robson, A.E. (Naval Research Lab., Washington, DC). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The Linus reactor concept is based upon a nondestructive, reversible, compression-expansion cycle in which a rotating liquid lithium liner is imploded mechanically, using high pressure helium as the energy source, and acts as a cylindrical piston to compress a magnetically-confined plasma adiabatically from a few hundred eV to about 15keV. The magnetic field at peak compression is $\sim$ 0.4 to 0.5MG, corresponding to a peak density of $\sim 10^{17}$ ions. cm^{-3}.

17874 (PPPL—1755, pp 212-215) **Preliminary studies of spheromak reactors.** Katsurai, M.; Yamada, M. (Princeton Univ., NJ). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

In this paper, we derived approximate functional relations between various spheromak plasma parameters, based on a simplified energy principle of circuit theory and using these relationships, have carried out preliminary studies of conceptual spheromak reactor with a stationary plasma as well as with a moving plasma produced by the cormak type formation scheme employed in the S-1 experiment at PPPL.

17875 (PPPL—1755, pp 216-219) **All plasma spheromak: the plasmak.** Koloc, P.; Ogden, J. (Prometheus II, Ltd., College Park, MD). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

There has been an evolutionary pattern established in magnetic fusion concepts. The flow in ideas follows three directions. By extrapolating this evolutionary movement, we have anticipated the concept called Spheromak and have predicted the omega of this evolution which is called PLASMAK, or Plasma Spheromak. The evolutionary directions are from open systems to closed systems, from zero or low dimensional compression schemes to three dimensional compression, and finally from plasma configurations without any self confining currents to a plasma configuration which is completely self confined except for the mechanical pressure necessary to maintain the verticle field and hoop stress. Nevertheless, the plasma is imprisoned by heavy poloidal coils and a vacuum wall.

17876 (PPPL—1755, pp 220-223) **Neutral beam sustained, field-reversed mirror reactors.** Carlson, G.A. (Lawrence Livermore Lab., CA); Schultz, K.R.; Smith, A.C. Jr. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

Conceptual design studies were completed for neutral beam sustained, field-reversed mirror reactors. The field-reversed mirror has a compact toroidal plasma geometry bounded by closed poloidal magnetic field lines generated by an azimuthal diamagnetic plasma current in a nearly uniform background magnetic field. The closed poloidal field structure has major radius R and minor radius a.

17877 (PPPL—1755, pp 224-227) **Moving-ring field-reversed mirror reactor concept.** Smith, A.C. Jr. (Pacific Gas and Electric Co., San Francisco, CA); Carlson, G.A.; Fleischmann, H.H.; Kammash, T.; Schultz, K.R.; Woodall, D.M. Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The Moving-Ring Field-Reversed Mirror Reactor (MRFRMR) concept envisions production of electric power by burning magnetically field-reversed rings of fusion fuel which are translated continuously down the bore of a straight, cylindrical reactor burner chamber. Our interest in this reactor scheme arises from its potential design simplicity and the hope that it might be piloted in small size (50 to 100 MW(e)). This reactor has been evaluated only on a preliminary basis thus far and much of the following discussion is founded on the results of that first evaluation.

17878 (PPPL—1755, pp 228-232) **Preliminary reactor implications of compact tori: how small is compact.** Krakowski, R.A.; Hagenson, R.L. (Los Alamos Scientific Lab., NM). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

The purpose of this paper is to present parametrically and by means of a simple analytic model the reactor implications of a FR θ P (field-reversed theta pinch); an electrically conducting shell is presumed necessary for equilibrium and stability. The question of minimum power and size for this specific CT configuration is addressed.

17879 (PPPL—1755, pp 233-236) **Tract: a small fusion reactor based on a compact torus plasma.** Willenberg, H.J.; Hoffman, A.L.; Steinhauer, L.C.; Rose, P.H. (Mathematical Sciences Northwest, Inc., Bellevue, WA). Mar 1981.

From Symposium on compact toruses and energetic particle injection; Princeton, NJ, USA (11 Dec 1979).

A compact torus formed by triggered reconnection and adiabatic compression of a reversed-field theta-pinch plasma can provide the basis for fusion power reactors which are small, relatively easy to fabricate and maintain, and which promise high power gain with modest recirculating power requirements. A new reactor concept, designated TRACT (Triggered Reconnection, Adiabatically Compressed Torus), has been developed based on such a confinement scheme. The TRACT plasma is produced in a linear solenoid by a staged process involving plasma formation in a reversed bias field, introduction of forward flux by external solenoidal shock coils, triggered reconnection of the magnetic field lines resulting in rapid axial compression and heating of the resultant plasma torus and, finally, some adiabatic compression of the plasma by additional forward flux. Plasmas formed in this manner have been experimentally observed to be stable for at least 100 Alfven times.

17880 **(PPPL-Q—37) Annual report, October 1, 1978-September 30, 1979.** (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1981. Contract AM02-76CH03073. 88p. NTIS, PC A05/MF A01.

This report covers the following areas: (1) PLT, (2) PDX, (3) smaller devices, (4) TFTR, (5) TFTR blanket module experiments, (6) engineering, (7) machine design and fabrication, and (8) advanced projects design and analysis, (9) design studies for new devices, (10) theory, (11) administration, and (12) graduate education. (MOW)

17881 **(SAND—80-2685C) Measurement of magnetically insulated line voltage using a Thomson Parabola Charged Particle Analyser.** Stanley, T.D.; Stinnett, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1981. Contract AC04-76DP00789. 24p. (CONF-810325—1). NTIS, PC A02/MF A01.

From Workshop on measurement of electrical quantities in pulsed power systems; Boulder, CO, USA (2 Mar 1981).

The absence of direct measurements of magnetically insulated line voltage necessitated reliance on inferred voltages based on theoretical calculation and current measurements. This paper presents some of the first direct measurements of magnetically insulated transmission line peak voltages. These measurements were made on the Sandia National Laboratories HydraMITE facility. The peak voltage is measured by observing the energy of negative ions produced at the line cathode and accelerated through the line voltage. The ion energy and the charge-to-mass ratio are measured using the Thomson Parabola mass spectrometry technique. This technique uses parallel E and B fields to deflect the ions. The deflected ions are detected using a microchannel plate coupled to a phosphor screen and photographic film. The Thomson Parabola results are compared to Faraday Cup measurements and to calculated voltages based on current measurements. In addition, the significance of observed positive ions is discussed.

17882 **(UCID—18798) MFTF-B physics requirements.** Porter, G.D.; Thomassen, K.I. (Lawrence Livermore National Lab., CA (USA)). 25 Mar 1981. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

The specifics of the physics requirements for the magnetic fields, diagnostics, particle and energy sources, and vacuum environment for the MFTF-B experiment are described. (MOW)

17883 **(UCID—18916) Fusion component design for the moving-ring field-reversed mirror reactor.** Carlson, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1981. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01.

This partial report on the reactor design contains sections on the following: (1) burner section magnet system design, (2) plasma ring energy recovery, (3) vacuum system, (4) cryogenic system, (5) tritium flows and inventories, and (6) reactor design and layout. (MOW)

17884 **(UCID—18948) Flexibility of MFTF-B for thermal-barrier modifications and axisymmetric upgrades.** Thomassen, K.I. (Lawrence Livermore National Lab., CA (USA)). 25 Mar 1981. Contract W-7405-ENG-48. 25p. NTIS, PC A02/MF A01.

Flexibility in MFTB-B will be achieved partly by using the margins in particle and energy control designed into the machine and partly by making modest changes based on results obtained in TMX Upgrade. This latter flexibility is permitted by the schedule for vessel construction and component fabrication. The changes we might expect were determined by an examination of the processes involved in creating a thermal barrier and by speculating on the range of outcomes from TMX Upgrade experiments.

17885 **(UCID—18989) Tandem mirror reactor studies at Lawrence Livermore National Laboratory, FY 1980.** Carlson, G.A.; Neef, W.S. Jr. (Lawrence Livermore National Lab., CA (USA)). 20 Mar 1981. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01.

The principles of tandem mirror operation with thermal barriers will be demonstrated in the upgrade of the Tandem Mirror Experiment (TMX-U) in 1981 and the tandem configuration of the Mirror Fusion Test Facility (MFTF-B) in 1984. Continued analysis and conceptual design over this period will evolve the optimal configuration and parameters for a power-producing reactor. In this article we describe the progress we have made in this reactor design study effort during 1980.

17886 **(UCRL—84549) System for automatic x-ray-image analysis, measurement, and sorting of laser fusion targets.** Singleton, R.M.; Perkins, D.E.; Willenborg, D.L. (Lawrence Livermore National Lab., CA (USA)). 1980. Contract W-7405-ENG-48. 16p. (CONF-801170—1). NTIS, PC A02/MF A01.

From 14. Asilomar conference on circuits, systems and computers; Pacific Grove, CA, USA (17 Nov 1980).

This paper describes the Automatic X-Ray Image Analysis and Sorting (AXIAS) system which is designed to analyze and measure x-ray images of opaque hollow microspheres used as laser fusion targets. The x-ray images are first recorded on a high resolution film plate. The AXIAS system then digitizes and processes the images to accurately measure the target parameters and defects. The primary goals of the AXIAS system are: to provide extremely accurate and rapid measurements, to engineer a practical system for a routine production environment and to furnish the capability of automatically measuring an array of images for sorting and selection.

17887 **(UCRL—85073) Operation of the 8-T, 1-m-diameter test facility at Lawrence Livermore National Laboratory.** Zbasnik, J.P.; Cornish, D.N.; Scanlan, R.M.; Leber, R.L.; Chaplin, M.R.; Rosdahl, A.R.; Johnston, J.E. (Lawrence Livermore National Lab., CA (USA)). 20 Mar 1981. Contract W-7405-ENG-48. 4p. (CONF-810340—1). NTIS, PC A02/MF A01.

From 7. international conference on magnet technology; Karlsrube, F.R. Germany (30 Mar 1981).

The High-Field Test Facility (HFTF) being built at Lawrence Livermore National Laboratory (LLNL) consists of a set of four Nb-Ti coils, inside of which there is a pair of multifilamentary Nb_3Sn coils. The outer coils are designed to generate 8 T in the 1-m bore; the Nb_3Sn coils will boost this to 12 T in a 40-cm bore. This paper describes the first operation of the complete set of Nb-Ti coils and describes and gives results from the data acquisition and analysis system that was used during the test.

17888 **Control of impurities in toroidal plasma devices.** Ohkawa, T. (to Dept. of Energy). US Patent 4,239,594. 16 Dec 1980. Filed date 29 Aug 1975. vp.

PAT-APPL-608985.

A method and apparatus for plasma impurity control in closed flux plasma systems such as tokamak reactors is disclosed. Local axisymmetrical injection of hydrogen gas is employed to reverse the normally inward flow of impurities into the plasma.

17889 **Clad materials for fusion applications.** Kaminsky, M. (Argonne National Lab., IL (USA)). *Thin Solid Films ;* **73**: No. 1, 117-132(3 Nov 1980).

From International conference on metallurgical coatings; San Diego, CA, USA (21 - 25 Apr 1980).

For the successful operation of plasma devices and future fusion reactors it is necessary to control plasma impurity release and surface erosion. One important way to control these processes is the use of materials with good thermal, electrical, mechanical and surface properties and ultrahigh vacuum compatibility. A promising class of materials was identified as composites produced by cladding. A development program was started to explore the explosion cladding of different materials of medium atomic number Z (e.g. V/OFHC copper and V/Nb/OFHC copper). Major features of the characterization of the bond interfaces of the claddings (using techniques such as scanning electron microscopy with X-ray energy analysis and optical metallography) are described, together with an outline of the testing program and some pertinent test results.

17890 **High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers.** Pawlewicz, W.T.; Hays, D.D.; Martin, P.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). *Thin Solid Films ;* **73**: No. 1, 169-175(3 Nov 1980).

From International conference on metallurgical coatings; San Diego, CA, USA (21 - 25 Apr 1980).

Optical coatings of the high band gap oxides ZrO_2, $Y_4Al_2O_9$, Al_2O_3, $MgAl_2O_4$ and SiO_2 were prepared by reactive sputtering to evaluate their potential for use in fusion lasers operating at wavelengths ranging from the UV to the near IR. The optical properties (refractive index, band gap, absorption and scattering) and materials properties (crystalline structure, grain size, stoichiometry and surface topography) of these oxides are reported and their suitability for use at 0.25 and 1.06 μm is discussed. The deposition rates and the influences of deposition conditions on the optical and materials properties are also reported.

99 GENERAL AND MISCELLANEOUS

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 16534, 16861

17891 **(BDX—613-2611) CMS plotter graphics training manual.** Cawby, R.D. (Bendix Corp., Kansas City, MO (USA)). Mar 1981. Contract AC04-76DP00613. 94p. NTIS, PC A05/MF A01.

This manual includes explanations of several graphics programs that use a Conversation Monitor System (CMS) terminal and a table-top plotter to produce a copy on bond paper or transparency film. 13 figures.

17892 **(CONF-810431—1) Standards and procedures for INTERACT.** Bonnet, J.M. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 1981. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From IDMS User Association data base conference; Atlanta, GA, USA (5 Apr 1981).

There is presented a checklist of items that writers of execute procedures should consider when developing procedures for public use or exchange among INTERACT user sites. An example using the checklist is also given. 4 figures.

17893 (CONF-810436—1) Inductive modeling of time series: a detrending approach. Kirk, B.L.; Rust, B.W. (Oak Ridge National Lab., TN (USA)). 1981. Contract W-7405-ENG-26. 8p. NTIS, PC A02/MF A01.

From Environmetrics '81 conference; Washington, DC, USA (6 Apr 1981).

The problem addressed involves the mathematical behavior of time series. One is often confronted with a data set that may possess a trend, even though the trend may not be detected by the naked eye. Spectral analysis (either Fourier amplitude spectrum analysis or maximum entropy spectral analysis) may aid in detecting cyclic trends in data, but trends are not necessarily cyclic. A code was developed that strips a time series of its trend. This trend may be a polynomial, an exponential, an autoregressive term, a sinusoid, a combination of these, or some other mathematical expression. As an illustration of the method described above, a time series that possesses very obvious trends is studied. 3 figures (RWR)

17894 (DOE/ER/02383—0078) Iterative solution of linear equations in ODE codes. Gear, C.W.; Saad, Y. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Jan 1981. Contract AS02-76ER02383. 34p. (UIUCDCS-R—81-1054; UILU-ENG—81-1703). NTIS, PC A03/MF A01.

Each integration step of a stiff equation involves the solution of a nonlinear equation, usually by a quasi-Newton method that leads to a set of linear problems. Iterative methods for these linear equations are studied. Of particular interest are methods that do not require an explicit Jacobian, but can work directly with differences of function values using J congruent to $f(x + \delta) - f(x)$. Some numerical experiments using a modification of LSODE are reported. 1 figure, 2 tables.

17895 (DOE/ER/02383—T1) Detection and integration of oscillatory differential equations with initial stepsize, order and method selection. Gallivan, K.A. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1980. Contract AS02-76ER02383. 70p. (UILU-ENG—80-1743; UIUCDCS-R—80-1045). NTIS, PC A04/MF A01.

Within any general class of problems there typically exist subclasses possessed of characteristics that can be exploited to create techniques more efficient than general methods applied to these subclasses. Two such subclasses of initial-value problems in ordinary differential equations are stiff and oscillatory problems. Indeed, the subclass of oscillatory problems can be further refined into stiff and nonstiff oscillatory problems. This refinement is discussed in detail. The problem of developing a method of detection for nonstiff and stiff oscillatory behavior in initial-value problems is addressed. For this method of detection a control structure is proposed upon which a production code could be based. An experimental code using this control structure is described, and results of numerical tests are presented. 3 figures.

17896 (DOE/ER/02383—T2) Difference methods for stiff delay differential equations. Roth, M.G. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1980. Contract AS02-76R02383. 143p. (UILU-ENG—80-1747; UIUCDCS-R—80-1012). NTIS, PC A07/MF A01.

Thesis.

Delay differential equations of the form $y'(t) = f(y(t), z(t))$, where $z(t) = [y_1(\alpha_1(y(t))),..., y/\text{sub } n/(\alpha/\text{sub } n/(y(t)))]/\text{sup } T/$ and $\alpha/\text{sub } i/(y(t)) \leq t$, arise in many scientific and engineering fields when transport lags and propagation times are physically significant in a dynamic process. Difference methods for approximating the solution of stiff delay systems require special stability properties that are generalizations of those employed for stiff ordinary differential equations. By use of the model equation $y'(t) = py(t) + qy(t-1)$, with complex p and q, the definitions of A-stability, A( )-stability, and stiff stability have been generalize to delay equations. For linear multistep difference formulas, these properties extend directly from ordinary to delay equations. This straight forward extension is not true for implicit Runge-Kutta methods, as illustrated by the midpoint formula, which is A-stable for ordinary equations, but not for delay equations. A computer code for stiff delay equations was developed using the BDF. 24 figures, 5 tables.

17897 (LA-UR—81-1024) Computing percentiles of large data sets. Howell, J.A. (Los Alamos National Lab., NM (USA)). 1981. Contract W-7405-ENG-36. 4p. (CONF-810342—1). NTIS, PC A02/MF A01.

From 13. symposium on the computer science and statistics interface; Pittsburgh, PA, USA (12 Mar 1981).

An algorithm for finding percentiles of large data sets (those having 100,000 or more points) is described. This algorithm does not involve sorting the entire data set. Instead, the data are sampled and a guess for the percentile is obtained. Then the guess is used to extract a subset of the original data through which a search for the true percentile is conducted. 2 tables.

17898 (SAND—81-0013) Recent developments in numerical ODES. Watts, H.A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1981. Contract AC04-76DP00789. 17p. (CONF-810113—6). NTIS, PC A02/MF A01.

From Simulation methods for nuclear power systems conference; Tucson, AZ, USA (Jan 1981).

A brief overview is presented of some of the recent developments in solving numerically the initial-value problem in ordinary differential equations. Three principal topics are discussed-problem classification and stiffness, methods and software, and matters of current and future interest.

17899 (SLAC—234) HANDYPAK: a histogram and display package (release 6.0). Boyarski, A. (Stanford Linear Accelerator Center, CA (USA)). Nov 1980. Contract AC03-76SF00515. 130p. NTIS, PC A07/MF A01.

HANDYPAK is a set of Fortran subroutines that a user may call for defining, accumulating, and preparing histograms or scatter plots. Sliced projections and statistical means and variances can be generated. Smooth curves and user-specified functions or contours may also be drawn. User blocks can be saved on disk, and can be retrieved from disk at a later time. Output can be directed to a line printer, or to a variety of graphic devices. Plotting formats may be changed by the user. This code is now in use on the IBM 370 OS and VM/CMS operating systems and the VAX/VMS system. 34 figures.

17900 (UCID—18981) PLTLIB: graphics library for Tektronix 4025 and 4027 terminals. Brand, H.R.; Yamauchi, R.K. (Lawrence Livermore National Lab., CA (USA)). 25 Jan 1981. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01.

A graphics library was written to plot experimental data in real time and to plot data analysis results interactively. The library is designed for use on Digital Equipment Corporation's (DEC) RT-11 and RSX-11M operating systems. The graphics devices are the Tektronix 4025 and 4027 terminals and the Tektronix 4662 plotter.

17901 (UCRL—85679) Influence of computer architectures on numerical algorithms. Rodrigue, G. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1981. Contract W-7405-ENG-48. 56p. (CONF-810334—3). NTIS, PC A04/MF A01.

From Workshop on high speed computing; Gleneden Beach, OR, USA (31 Mar 1981).

This paper discusses areas that affect numerical algorithms, how these areas affect numerical algorithms, examples of how computers have influenced numerical algorithms in both the past and the present, and some of the difficulties in developing numerical algorithms. Only the viewgraphs are given here; there is no text. (RWR)

17902 (UCRL—85680(VUGRAPH)) Review and future actions. Michael, G.A. (Lawrence Livermore National Lab., CA (USA)). 31 Mar 1981. Contract W-7405-ENG-48. 18p. (CONF-810334—4). NTIS, PC A02/MF A01.

From Workshop on high speed computing; Gleneden Beach, OR, USA (31 Mar 1981).

Viewgraphs from a talk on high-speed computing are given. Areas discussed include test problems, architectures, algorithms, languages, and performance goals. Only viewgraphs are presented; there is no text. (RWR)

17903 **Shape of a pendent liquid drop.** Concus, P. (Univ. of California, Berkeley); Finn, R. *Philosophical Transactions of the Royal Society of London, Series A ;* **292**: No. 1391, 307-340(31 Aug 1979).

A characterization is given for the most general equilibrium configuration of a symmetric pendent liquid drop. It is shown that for any vertex height, u_0, the vertical section can be continued globally as an analytic curve, without limit sets or double points. For small absolute value u_0 it is proved the section projects simply on the axis $u = 0$; for large absolute value u_0 the section is shown to have near the vertex the general form of a succession of circular arcs joined near the axis by small arcs of large curvature. The section contracts at first toward a certain hyperbola, the circular arcs gradually changing shape but remaining, until a certain fixed height (asymptotically as $u_0 \to -\infty$), within a narrow band surrounding the hyperbola. The continuation of the section eventually projects simply on $u = 0$, separates from the hyperbola, and continues in an oscillatory manner to infinity. The properties described above are studied quantitatively. It is conjectured that as absolute value $u_0 \to \infty$ the section converges uniformly (as a point set) to a solution $U(r)$ with simple projection (for all $r > 0$) on $u = 0$ and an isolated singularity at $r = 0$. A preliminary (weak) form of the conjecture is proved. The (liquid drop) solutions are also studied from the point of view of their global embedding in the manifold of all formal solutions of the equations. From this point of view, the vertex of the drop appears as a transition point marking a change in qualitative appearance. It is conjectured that the only global solution without double points, in this extended sense, is the singular solution referred to above. 17 figures.

9903 Information Handling

REFER ALSO TO CITATION(S) 16431, 17446

17904 **(PB—80-212483) Environmental assessment data systems user guide: Solid Discharge Data System. Final report, September 1978-September 1979.** Larkin, R.J. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Jan 1980. Contract EPA-68-02-2699. 265p. NTIS, PC A12/MF A01.

The report is a user guide to the Solid Discharge Data System (SDDS), a computerized data base on solid waste discharges from stationary point sources. The SDDS is one of four waste stream data bases which are components of the Environmental Assessment Data Systems (EADS). The EADS concept has been designed to aid researchers in environmental assessment, emissions characterization, and control technology development. The SDDS contains data from source sampling which may include: design and typical operating data on control technology applied to the solid waste effluent stream; analysis of any fuel or feedstock to the process producing the effluent stream; results of chemical, physical, radiological, and biological/ecological tests of solid waste samples; process descriptions of the sources; and descriptions of the sampling equipment and techniques employed. The SDDS protocol is consistent with Level 1 and 2 reporting requirements. The guide gives detailed procedures for encoding SDDS data sets, defines procedures for submitting and retrieving data, and contains standard nomenclature to facilitate data encoding. It also contains a program library that describes analytical software available to the user and provides instructions for its use. The report also discusses procedures which allow its users to access the SDDS directly or through the EPA project officer.

17905 **(PB—80-222433) Environmental assessment data systems user guide: Fine Particle Emissions Information System. Final report, September 1978-September 1979.** Reider, J.P.; Larkin, R.J. (Midwest Research Inst., Kansas City, MO (USA)). Jan 1980. Contracts EPA-68-02-2641;EPA-68-02-2699. 290p. NTIS, PC A13/MF A01.

The report is a user guide to the Fine Particle Emissions Information System (FPEIS), a computerized data base on particulate emissions from stationary point sources. The FPEIS is one of four waste stream data bases which are components of the Environmental Assessment Data Systems (EADS). The EADS concept has been designed to aid researchers in environmental assessment, emissions characterization, and control technology development. The FPEIS contains data from source sampling which may include: particle size distributions; design and typical operating data on control technology applied to the particle-laden effluent stream; analysis of any fuel or feedstock to the process producing the effluent stream; results of chemical, physical, radiological, and biological/ecological tests of particulate samples; process descriptions of the sources; and descriptions of the sampling equipment and techniques employed. The FPEIS protocol is consistent with Level 1 and 2 reporting requirements. The guide gives detailed instructions for encoding FPEIS data sets, defines procedures for submitting and retrieving data, and contains standard nomenclature to facilitate data encoding. It also contains a program library that describes analytical software available to the user and provides instructions for its use. The report also discusses procedures which will allow its users to access the FPEIS.

17906 (TR—80/031-001, pp 223-245) **Comparative analysis of peat gasification reactor configurations.** Kuo, D.M. (UOP, Inc./System Development Corp., McLean, VA). 1980.

From 1. technical contractors' conference on peat; Rockville, MD, USA (11 Mar 1980).

The US Department of Energy (DOE) began its Peat Gasification Project in mid-1976 to develop an economical and environmentally acceptable technology for converting peat to gaseous or liquid products. Once it has been developed, the US will be able to use the estimated 1443 quads (10^{15} Btu) of energy in its peat reserves. UOP/SDC is reviewing and analyzing available peat gasification data and developing computer models of peat gasifiers. Based on results of this work, UOP/SDC will recommend a peat gasifier configuration for the DOE peat gasification pilot plant project. This report presents the results of UOP/SDC's analysis of peat gasification data bases developed independently by the Institute of Gas Technology (IGT) and Rockwell International. To provide a background for the analysis, some aspects of peat gasification, peat properties and gasification characteristics, and reactor configurations are discussed briefly. Conclusions from the study and recommendations for further experimentation are also presented.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

A

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Adams (Samuel S.) and Associates, Boulder, CO (USA)
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Coal-slurry test loop: development and operation, 6:16456 (NYSERDA—80-23)

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Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow column), 6:16352 (DOE/ET/14801—6)
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Wind energy resource atlas. Volume 10. Alaska region, 6:16769 (PNL—3195-WERA-10)

Alaska Univ., Fairbanks (USA). Geophysical Inst.
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))

Aluminum Co. of America, Alcoa Center, PA
Design studies of an aluminum first wall for INTOR, 6:17828 (BNL—29190)

American Electronic Labs., Inc., Montgomeryville, PA (USA)
Pessel-AEL flue-gas desulfurization process. Final report, 6:16404 (DOE/IR/06355—T1)

American Gas Association Labs., Cleveland, OH
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)
Improvements in appliance efficiency. Task II. Improvement of commercial cooking equipment. Annual report for 1979, 6:16971 (PB—80-210727)
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Electric utility rate design study: costs and benefits of load management to society, 6:16933 (NP—22593)

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Application of selected chemical reactions to the organic chemistry of coal, 6:16397 (IS-T—948)
Crystal-structure determinations of Lu_3S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)
Study of different forms for the recombination function in the formation of mesons from partons, 6:17657 (IS-T—929)

Applied Research Associates, Inc., Albuquerque, NM (USA)
Full-scale load tests of experimental solar-collector foundations, 6:16718 (SAND—80-7076)

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Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report, 6:16405 (EPRI-CS—1579(Vol.3)(Add.))

Argonne National Lab., IL (USA)
Advanced fuel-cell development. Progress report, January-March 1980, 6:16946 (ANL—80-67)
Application of a methodology for evaluation of intertechnology tradeoffs: an illustrative case study, 6:16899 (ANL/EES-TM—127)
Chemistry of bottom sediments from the Cal-Sag channel and the Des Plaines and Illinois Rivers between Joliet and Havana, Illinois, 6:17433 (ANL/ES—112)
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
COMMIX-SA-1: a three-dimensional thermohydrodynamic computer program for solar applications, 6:16724 (ANL—80-8)
Comparative health and safety assessment of alternative future electrical-generation systems, 6:17451 (CONF-800567—6)
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments, 6:17065 (CONF-800523—4)
Effects of curvature on asymmetric steady states in catalyst particles, 6:17163 (ANL—81-7)
Electron transfer in systems of well-defined geometry, 6:17186 (DOE/ER/10392—4)
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Energy and materials flows in the production of liquid and gaseous oxygen, 6:16986 (ANL/CNSV—15)
Energy savings attributable to switching from master metering to individual metering of electricity, 6:16956 (ANL/EES-TM—124)
Implementation planning for industrial energy conservation: approach and methodology, 6:16987 (ANL/CNSV-TM—55)

Labor productivity in heavy construction: impact on synfuels program employment, 6:17447 (ANL/AA—24)
Particulate deposition from turbulent parallel streams, 6:17624 (ANL/MHD—81-2)
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Post-irradiation handling and examination at the HFEF complex, 6:16856 (CONF-800592—9)
QCD corrections to quarkonia decays, 6:17652 (ANL-HEP-CP—80-60)
Residential solar-photovoltaic power systems: the need for battery storage, 6:16667 (CONF-800567—5)
Results of an accuracy test of the Mod-II Site Data Acquisition System, 6:16688 (ANL/EES-TM—128)
Role of brain maturation and reproductive history in the evolution of the primate brain, 6:17500 (CONF-8004147—1)
Studies on mathematical models for characterizing plume and drift behavior from cooling towers. Executive summary, 6:17351 (EPRI-CS—1683-SY)
Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)
Thermal-performance study of liquid metal fast breeder reactor insulation, 6:16837 (ANL—80-97)
Wave-driver options for low-aspect-ratio steady-state tokamak reactors, 6:17826 (ANL/FPP/TM—141)
Why most flavor-dependence predictions for nonleptonic charm decays are wrong: flavor symmetry and final-state interactions in nonleptonic decays of charmed hadrons, 6:17653 (ANL-HEP-CP—80-64)

Arizona State Univ., Tempe (USA)
Measurement of the decay rate of the Dalitz decay of the neutral pion, 6:17649

Arizona State Univ., Tempe (USA). Coll. of Architecture
Hardware package and workshop development for homeowner solar water heater, 6:16700 (DOE/SF/01973—T1)

Arizona Univ., Tucson (USA)
Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay, 6:17468 (DOE/ER/04927—T3)
Direct observation of electron transfer across a lipid bilayer: laser photolysis of an asymmetric vesicle system containing chlorophyll, methyl viologen, and EDTA, 6:17466 (DOE/ER/04927—T1)
Environmental effects on electron transfer from chlorophyll triplet to quinone: role of dielectric constant, viscosity and quinone structure in cellulose acetate films, 6:16640 (DOE/ER/04927—T4)

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B

Battelle Columbus Labs., OH (USA)
Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report, 6:16882 (SAND—80-7191)
Construction materials for wet scrubbers. Final report, 6:16795 (EPRI-CS—1736(Vol.1))
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Development of a plastic fracture methodology. Final report, 6:16849 (EPRI-NP—1734)
Laser fusion systems for industrial process heat. Final report, 6:17834 (DOE/TIC—11435(Vol.1))
Laser fusion systems for industrial process heat. Final report, 6:17835 (DOE/TIC—11435(Vol.2))
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NWTS program criteria for mined geologic disposal of nuclear wasite: site performance criteria, 6:16560 (DOE/NWTS—33(2))

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Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu, 6:17733 (EPRI-NP—1763)
Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station, 6:17524 (PNL—3409)
Foreign industry energy effectiveness. Final report for 1979, 6:17037 (PB—80-210743)
Hanford Personnel Dosimeter supporting studies FY-1980, 6:17305 (PNL—3536)
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
Potential influence of organic compounds on the transport of radionuclides from a geologic repository. Assessment of effectiveness of geologic isolation systems, 6:16580 (PNL—3414)
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for October-December 1980, 6:16591 (PNL—1845-49)
Regional variations in US residential-sector fuel prices: implications for development of building energy-performance standards, 6:16976 (PNL—3605)
Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)
Thermal conductivity of multibarrier waste form components, 6:16566 (PNL—3090)
Time and temperature dependence of the leaching of a simulated high-level waste glass, 6:16567 (PNL-SA—9054)

Bechtel National, Inc., San Francisco, CA (USA)
Impact of coal cleaning on the cost of new coal-fired power generation. Final report, 6:16447 (EPRI-CS—1622)
Second generation heliostat development for solar central receiver systems detailed design report. Volume II. Appendices, 6:16683 (SAND—79-8194(Vol.2)(App.))

Bell Aerospace Textron, Buffalo, NY (USA)
High-mass-flux coal gasifier. First quarterly technical progress report, 28 September-21 December 1979, 6:16351 (DOE/ET/14674—T1)

Bendix Corp., Kansas City, MO (USA)
Clean room wiping cloths, 6:17205 (BDX—613-2566)
CMS plotter graphics training manual, 6:17891 (BDX—613-2611)
Etchback smear removal process characterization. Final report, 6:17237 (BDX—613-2598)
Finite-element-method study of stresses on simulated electronic components encapsulated in polystyrene-bead foam, 6:17236 (BDX—613-2551)
Gage chucking mechanism. Final report, 6:17204 (BDX—613-2560)
Laser machining of ceramic, 6:17235 (BDX—613-2507)
Low-temperature curing of a nitrile-epoxy adhesive. Final report, 6:17136 (BDX—613-2553)

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Importance of resolution for helium detectors used in uranium exploration, 6:16537 (GJBX—38(81))

Statistical techniques applied to aerial radiometric surveys (STAARS): principal components analysis user's manual, 6:16534 (GJBX—9(81))
United States Department of Energy, Grand Junction Office, 6:16532 (GJO—112(81))

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Coal and the environment abstract series: mine drainage bibliography 1929-1980. Final report, 6:16416 (PB—80-221062)
Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980, 6:16354 (DOE/ET/14815—20)
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Boeing Co., Seattle, WA (USA)
Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico, 6:16708 (SOLAR/1008—80/50)

Boeing Engineering and Construction Co., Seattle, WA (USA)
Pacific bulk commodity transportation system, executive summary. Final report, 6:16449 (PB—80-222565)
Pacific bulk commodity transportation system, Volume II. final report, 6:16450 (PB—80-222573)

Bonneville Power Administration, Portland, OR (USA)
Network wind power over the Pacific Northwest. Wind statistics summaries for the wind power data stations, 6:16766 (DOE/BP/01310—T1(App.2))

Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)
Site Development Planning Handbook, 6:17424 (DOE/AD/06212—1)

Booz, Allen and Hamilton, Inc., Cleveland, OH (USA)
Second generation heliostat development for solar central receiver systems detailed design report. Volume II. Appendices, 6:16683 (SAND—79-8194(Vol.2)(App.))

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Economic impact of implementing RACT (reasonably available control technology) guidelines in the state of Kentucky. Final report, 6:17388 (PB—80-206980)

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Assessment of international tar sands recovery and upgrading processes, 6:16527 (UCRL—15323)

Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.
Fourth symposium on macrocyclic compounds, 6:17177 (DOE/ER/10605—4)

Brookhaven National Lab., Upton, NY (USA)
Acceleration of polarized protons in the Brookhaven AGS, 6:17255 (BNL—29295)
AGS fast kicker magnet system, 6:17265 (BNL—29187)
Beam - and drive - controlled amplifier for the ISABELLE accelerating system, 6:17289 (BNL—29196)
Considerations of an air-quality standard to protect terrestrial vegetation from acidic precipitation, 6:17527 (BNL—29097)
Critical organ concentration of cadmium in occupationally-exposed workers, 6:17526 (BNL—29066)
Design of fast kickers for the ISABELLE beam abort system, 6:17293 (BNL—29218)
Design studies of an aluminum first wall for INTOR, 6:17828 (BNL—29190)
Development of multiampere negative ion sources, 6:17827 (BNL—29159)
Edge focusing, 6:17252 (BNL—29211)
First cell magnet system tests, 6:17294 (BNL—29232)
Fleet-Car Market PENetration Simulator: CPEN user's guide, 6:17064 (BNL—51286)
Free electron laser experiment at the NSLS 700 MeV electron storage ring, 6:17291 (BNL—29209)
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
Higher-order terms in a perturbation expansion for the impedance of a corrugated wave guide, 6:17268 (BNL—29213)
Hydrogen production from small hyropower sites. Final report, 6:16592 (BNL—51309)
Improved copper septum magnet design, 6:17261 (BNL—29083)
Inhomogeneities in magnetic field due to variations of lamination gap heights, 6:17253 (BNL—29212)
ISABELLE cavity gap assemblies, 6:17285 (BNL—29091)
ISABELLE magnet power supply system performance analysis, 6:17286 (BNL—29188)
ISABELLE superconducting power distribution system, 6:17290 (BNL—29197)
Leak checking in ISABELLE, 6:17262 (BNL—29148)
Magnetic properties of ISABELLE superconducting quadrupoles, 6:17288 (BNL—29195)
Marine boundary layer wind structure over the Bay of Bengal during MONEX79, 6:17342 (BNL—29260)
Marshall Islands: a study of diet and living patterns, 6:17542 (BNL—51313)
Mechanical properties of ISABELLE superconducting coils, 6:17295 (BNL—29236)
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
MEQALAC development at Brookhaven, 6:17271 (BNL—29305)
New AGS slow external beam switchyard, 6:17264 (BNL—29176)
Optical emission studies of reactive species in plasma deposition, 6:17137 (BNL—29161)
Outgassing rate of the copper-plated beam tube for ISABELLE, 6:17292 (BNL—29217)
Overview of multifluid-flow-calculation methods, 6:17224 (BNL—29189)
Phenomenology of CP violation from the Kobayashi-Maskawa model, 6:17669 (BNL—29074)
Polymer-cement geothermal-well-completion materials. Final report, 6:16748 (BNL—51287)
Proceedings of the second international symposium on the production and neutralization of negative hydrogen ions and beams, 6:17567 (BNL—51304)
Programs and subroutines for calculating cadmium body burdens based on a one-compartment model, 6:16854 (BNL—51306)
Pulsed rf operation analysis, 6:17296 (BNL—29241)
R.F. cavity design for the NSLS, 6:17269 (BNL—29226)
Rf power systems for the national synchrotron light source, 6:17267 (BNL—29210)
Seasonal variations in light scattering in the New York region and their relation to sources, 6:17349 (BNL—29271)
Spiral design and beam dynamics for a variable energy cyclotron, 6:17251 (BNL—29201)
Status of the National Synchrotron Light Source control system, 6:17266 (BNL—29208)
Status of the National Synchrotron Light Source project, 6:17270 (BNL—29242)
Study of factors which affect training in ISABELLE R and D magnets, 6:17287 (BNL—29194)
Study of gap states in a-Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells, 6:16637 (BNL—29160)
Symposium on neutron cross-sections from 10 to 50 MeV, 6:17681 (DOE/NDC—21/L(Vol.1))
Symposium on neutron cross-sections from 10 to 50 MeV, 6:17685 (DOE/NDC—21/L(Vol.2))
Tell el Yahudiyeh Ware: a re-evaluation, 6:17156 (BNL—29258)
Tests of a 3 meter curved superconducting beam transport dipole magnet, 6:17263 (BNL—29174)
Underground hydrogen storage. Final report, 6:16598 (BNL—51275)
Upgraded coil configuration for ISABELLE magnets, 6:17297 (BNL—29307)
Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)
Vertical fast blow-up in a single bunch, 6:17254 (BNL—29215)
Way to observe the Higgs boson H^0 in hadronic interactions, 6:17627 (BNL—29072)
Zirconia fuel cells and electrolyzers, 6:16947 (BNL—29133)

Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems
Approach to market-penetration analysis for advanced electric-power-generation technologies, 6:16926 (BNL—51285)
Estimates of occupational safety and health impacts resulting from large-scale production of major photovoltaic technologies, 6:16631 (BNL—51324)
Impact of energy and environmental legislation on industry: problems of regulatory cost assessment, 6:16893 (BNL—28956)
Issues in the use of wood as an energy source in the northeastern US, 6:16638 (BNL—51196)

Brown Univ., Providence, RI (USA). Dept. of Physics
Comparing O(N) and SU(N) x SU(N) spin systems in 1 + 1 dimensions to SU(N) gauge theories in 3 + 1 dimensions, 6:17675 (DOE/ER/03130—T1)
Natural flavor conservation, 6:17670 (DOE/ER/01545—301)
Study of Λ parameters and crossover phenomena in SU(N) x SU(N) sigma models in two dimensions, 6:17676 (DOE/ER/03130—T2)

Bureau of Land Management, New Orleans, LA (USA). New Orleans Outer Continental Shelf Office
Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69, 6:16500 (NP—25371)
Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center
Reducing dust at longwall shearers by confining the dust cloud to the face, 6:16424 (BM-TPR—111)
Bureau of Mines, Spokane, WA (USA). Spokane Research Center
Inorganic cement for mine roof-bolt grouting, 6:16423 (BM-RI—8494)
Bureau of Mines, Tuscaloosa, AL (USA). Tuscaloosa Research Center
Dewatering of industrial clay wastes, 6:17423 (BM-RI—8498)

C

California Energy Commission, Sacramento (USA)
Commission decision on the Department of Water Resources' Application for Certification for the Bottle Rock Geothermal Project, 6:16746 (P—800-80-013)
Guide to financial assistance for wind energy, 6:16771 (P—500-81-014)
Guide to the energy conservation regulations for new nonresidential buildings, 6:16968 (P—400-80-069)
Proposed residential building standards: draft environmental impact report, 6:16969 (P—700-80-013)
California Energy Commission, Sacramento (USA). Synthetic Fuels Office
Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)
California Inst. of Tech., Pasadena (USA)
Recent results from the CFRR neutrino experiment at Fermilab, 6:17629 (DOE/ER/02232—97)
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets, 6:17646
California State Dept. of Transportation, Sacramento (USA). Transportation Lab.
CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Model-simulation, 6:17367 (PB—80-220833)
CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Interim report, 6:17368 (PB—80-220841)
Transportation systems and regional air quality - photochemiCal modeling of Sacramento, California region. Interim report, April 1976-October 1979, 6:17359 (PB—80-210800)
California Univ., Berkeley (USA)
Possible deviations from (V-A) charged currents: precise measurement of muon decay parameters, 6:17631 (LBL—12275)
California Univ., Berkeley (USA). Donner Lab.
Imaging properties of a positron tomograph with 280 BGO crystals, 6:17491 (LBL—11858)
California Univ., Berkeley (USA). Lawrence Berkeley Lab.
Energy and Environment Division annual report, 1979, 6:17355 (LBL—11650)
California Univ., Davis (USA)
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region, 6:17717
California Univ., Davis (USA). Dept. of Mechanical Engineering
X-ray diffraction study of residual stress in model weldments. Final report, 6:17109 (UCRL—15332)
California Univ., Livermore (USA). Lawrence Livermore Lab.
Diagnostic test systems canister weld joint analysis, 6:17212 (UCID—18750)
Electricity generation by solar central receivers, 6:16682 (UCID—18977)
Electronics Engineering Department. Quarterly report No. 3, 1980, 6:17238 (UCRL—50025-80-3)
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS), 6:16878 (CONF-791258—(Summ.))
Fusion component design for the moving-ring field-reversed mirror reactor, 6:17883 (UCID—18916)
Oil shale project small retort run summary, Run S-15. Addendum. Computer tables, 6:16526 (UCID—18282(Rev.1))
Potential impacts of geothermal development on outdoor recreational use of the Salton Sea, 6:16745 (UCRL—13897(Rev.1))
California Univ., Livermore (USA). Lawrence Livermore National Lab.
Effect of vinyl and phenyl contents of silicone gum on the properties of the elastomers and cellular silicone cushions, 6:17132 (UCRL—53105)
California Univ., Los Angeles (USA)
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)
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Review of the upper Cenozoic stratigraphy overlying the Columbia River Basalt Group in western Idaho, 6:17545 (RHO-BWI-C—87)
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Physics calculations for preliminary feasibility studies of fusion blanket testing in ETR, 6:17836 (EGG-PHYS—5392)
TRAC-BD1: transient reactor analysis code for boiling-water systems, 6:16862 (CONF-810307—3)
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Search for parity non-conservation polarized proton-nucleon scattering at 6 GeV/c, 6:17650
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Study of diffusion of oxygen in dilute vanadium alloys using solid electrolytic cells, 6:17085 (DOE/ER/01198—1343)
Illinois Univ., Urbana (USA). Dept. of Chemistry
Electron transfer in systems of well-defined geometry, 6:17186 (DOE/ER/10392—4)
Illinois Univ., Urbana (USA). Dept. of Computer Science
Detection and integration of oscillatory differential equations with initial stepsize, order and method selection, 6:17895 (DOE/ER/02383—T1)
Difference methods for stiff delay differential equations, 6:17896 (DOE/ER/02383—T2)
Iterative solution of linear equations in ODE codes, 6:17894 (DOE/ER/02383—0078)
Illinois Univ., Urbana (USA). Dept. of Physics
Comparing O(N) and SU(N) x SU(N) spin systems in 1 + 1 dimensions to SU(N) gauge theories in 3 + 1 dimensions, 6:17675 (DOE/ER/03130—T1)

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Effect of bed and jet parameters on vertical jet penetration length in gas fluidized beds, 6:17239 (CONF-801104—13)
Effects of sulfur-containing gases on the performance of molten carbonate fuel cells, 6:16951 (EPRI-EM—1699)
Memphis demonstration plant program, 6:16344 (CONF-800878—2)
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Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)

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L

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Electromagnetic (EM-69) survey of the McCoy geothermal prospect, Nevada, 6:16739 (LBL—12012)
Energy Analysis Program, FY 1980, 6:16888 (LBL—11972)
Imaging properties of a positron tomograph with 280 BGO crystals, 6:17491 (LBL—11858)
Liquefaction of Douglas Fir wood slurries: titration of acids and anions in aqueous product and feed slurries, 6:16606 (LBL—12331)
Organic contaminants: a bibliography, 6:17356 (LBL—12199)
Practical neutron dosimetry at high energies, 6:17743 (LBL—11652)
Stochastic cooling of 200 MeV protons, 6:17260 (LBL—10757)
Study of precipitate morphology by consideration of elastic strain energy, 6:17103 (LBL—10639)
Test results and methods: residential air-to-air heat exchangers for maintaining indoor air quality and saving money, 6:16964 (LBL—12280)
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
Well-bore effects in the analysis of two-phase geothermal well tests, 6:16753 (LBL—12220)

Lawrence Livermore National Lab., CA (USA)
Advanced Test Accelerator (ATA) pulse power technology development, 6:17282 (UCRL—85037)
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
Application of structure-property relationships to develop seven segmented polyurethane adhesives, 6:17133 (UCRL—84039)
Application of SYNROC to high-level defense wastes, 6:16572 (UCRL—85032)
Application program performance measurements, 6:17625 (UCRL—85677-VUGRAPH)
Applications of shallow solar ponds in wastewater treatment, 6:16720 (UCRL—15329)
California energy flow in 1979, 6:16955 (UCID—18991)
Coherence in laser excitation, 6:17221 (UCRL—84260)
Design and performance of the 1.5 MV injector for FXR, 6:17283 (UCRL—85060)
Evaluation of fiber-optic connectors, 6:17213 (UCRL—53116)
Experimental plan for 40-m^3 liquefied natural gas (LNG) dispersion tests. 1981 tests, 6:16515 (UCID—18585(Suppl.1))
Flexibility of MFTF-B for thermal-barrier modifications and axisymmetric upgrades, 6:17884 (UCID—18948)
FPPAC: a two-dimensional multispecies nonlinear Fokker-Planck package, 6:17802 (UCRL—85666)
Influence of computer architectures on numerical algorithms, 6:17901 (UCRL—85679)
MFTF-B physics requirements, 6:17882 (UCID—18798)
New photographic technique for observing bulk laser damage, 6:17078 (UCRL—84843)
Observed turbulence intensities in a desert boundary layer, 6:17345 (UCRL—84672)
Operation of the 8-T, 1-m-diameter test facility at Lawrence Livermore National Laboratory, 6:17887 (UCRL—85073)
PLTLIB: graphics library for Tektronix 4025 and 4027 terminals, 6:17900 (UCID—18981)
Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9), 6:16571 (UCID—18845)
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
Review and future actions, 6:17902 (UCRL—85680(VUGRAPH))
Review of methods for evaluating R and D, 6:16906 (UCID—18890)
Roadway powered electric vehicle (RPEV) system concept description and project overview, 6:17073 (UCRL—85425)
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
System for automatic x-ray-image analysis, measurement, and sorting of laser fusion targets, 6:17886 (UCRL—84549)
Tandem mirror reactor studies at Lawrence Livermore National Laboratory, FY 1980, 6:17885 (UCID—18989)
Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature, 6:17554 (UCRL—83789(Rev.1))
Two-wavelength HeNe laser interferometer, 6:17801 (UCID—18988)

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Bonding solar selective absorber foils to glass receiver tubes for use in evacuated tubular collectors: preliminary studies, 6:16712 (LA-UR—81-1023)
Computing percentiles of large data sets, 6:17897 (LA-UR—81-1024)
Controlling hydrogen behavior in light water reactors, 6:16873 (LA-UR—81-681)
Improved aluminum coatings for the ultraviolet, 6:17102 (LA-UR—81-747)
Los Alamos proton-storage-ring extraction system, 6:17259 (LA-UR—81-784)
Neutralization of H^- beams by magnetic stripping, 6:17209 (LA-UR—81-831)
New applications of particle accelerators in medicine, materials science, and industry, 6:17249 (LA-UR—81-818)
NMR measurements on Western Gas Sands core, 6:16508 (LA-UR—81-736)
Plasma physics plotting package, 6:17763 (LA—8161-M)
Preliminary Hot Dry Rock geothermal evaluation of Long Valley Caldera, California, 6:16738 (LA—8710-HDR)
Reactions of HS radicals important in coal combustion. Project status report, January 1-March 31, 1981, 6:16454 (DOE/TIC—11441)
Remote characterization of tight gas sand formations with a new NMR logging tool, 6:16507 (LA-UR—81-735)

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Absorption spectra of AgI at pressures to 136 kbar, 6:17142 (LA-UR—81-1021)
Determination of protection factors for tandem HEPA filters, 6:17354 (LA-UR—81-729)
Drainage flow over complex terrain, 6:17353 (LA-UR—80-3052)
Electronic weighing, identification and subdermal body temperature sensing of range livestock, 6:17511 (LA-UR—81-748)
Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, October 1-December 31, 1980, 6:16844 (LA—8742-PR)

Flash pyrolysis of coal through solar heating, 6:16378 (LA-UR—81-764)
Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau, 6:16737 (LA—8676-T)
Geostatistics project of the National Uranium Resource Evaluation program. Progress report, April-September 1980, 6:16548 (GJBX—99(81))
High-precision multipass reflectometer, 6:17328 (LA-UR—81-679)
ICRF oscillations of an inhomogeneous plasma cylinder, 6:17767 (LA-UR—81-682)
Intense low-emittance-electron-gun development at PHERMEX, 6:17280 (LA-UR—81-783)
Ionospheric modification by high-power radio waves, 6:17565 (LA-UR—81-870)
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
LAMPF dual-energy operation, 6:17257 (LA-UR—81-730)
LAMPF hardware beam transmission monitor systems, 6:17277 (LA-UR—81-731)
Lasers as a tool for plasma diagnostics, 6:17768 (LA-UR—81-896)
LASL Nb_3Ge conductor development. Sixteenth quarterly progress report, April 1-June 30, 1980, 6:16812 (LA—8606-PR)
LA-UR—81-859, 6:17529 (CONF-810350—1)
Method of inferring the magnetic field profiles in the reversed-field pinch, 6:17766 (LA —8738-MS)
Novel current monitor for DC and modulated magnets in the proton storage ring, 6:17299 (LA-UR—81-781)
Nuclear waste disposal facility intrusion: an archeologist's perspective, 6:16561 (LA-UR—81-830)
Observations of plasma tearing instabilities and associated axial translation in field-reversed experiments, 6:17765 (LA—8729-MS)
Phase and bunch shape measurement in the UNILAC with capacitive probes, 6:17276 (LA-tr—80-42)
Phase probe measuring system in the UNILAC: probe dimensioning and signal evaluation, 6:17284 (LA-tr—80-43)
Prospects for pion and kaon factories, 6:17278 (LA-UR—81-746)
Pulsed versus direct current calibration of a proximity focused x-ray streak camera, 6:17764 (LA—8425-MS)
Rail gun program, 6:17208 (LA—8669-MS)
Reactors for nuclear electric propulsion, 6:16859 (LA-UR—81-703)
Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)
Redesign of the LAMPF transition region, 6:17258 (LA-UR—81-737)
Status of the Los Alamos gyrocon, 6:17279 (LA-UR—81-772)
Whispering-mode waveguide, 6:17755 (LA-UR—81-994)

Louisiana State Univ., Baton Rouge (USA). Choppin Chemical Labs.
Fundamental spectroscopic studies of some atmospheric pollutants, 6:17343 (CONF-8005149—1)

M

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Overall plant design description for collector subsystem for the 10-MW/sub e/ solar-thermal central-receiver pilot plant. Phase 1, 6:16678 (MCR—79-1311)

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Flyer sensitivity test, 6:17337 (MHSMP—81-09)
High Z (ash) analysis of TATB, 6:17338 (MHSMP—81-10)
Study of PETN/LX-13 from semi-continuous recrystallized Mil. Spec. PETN, 6:17336 (MHSMP—81-08)

Massachusetts Inst. of Tech., Cambridge (USA)
Coincidence lattice model for the structure and energy of grain boundaries, 6:17747 (DOE/ER/05002—16)
Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)
Development of models for the sodium version of the two-phase three-dimensional thermal hydraulics code THERMIT, 6:16868 (DOE/ET/37218—3)
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Reliability of terrestrial photovoltaic modules at various DOE/MIT Lincoln Laboratory Test Sites, 6:16670 (DOE/ET/20279—126)
Solar photovoltaic residence in Carlisle, Massachusetts, 6:16671 (DOE/ET/20279—129)
Three-year performance study of the Mead, Nebraska, 25-kWp photovoltaic power system, 6:16669 (DOE/ET/20279—122)

Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice
Development of a packed-bed letdown valve for coal-liquefaction plants, 6:16382 (ORNL/MIT—321)
Simulation of three-phase fluidized bioreactors for denitrification, 6:16564 (ORNL/MIT—324)

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Michigan Univ., Ann Arbor (USA)
Aggregation of sodium alkylbenzenesulfonates in aqueous solution, 6:16465 (CONF-810308—11)
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Midwest Research Inst., Kansas City, MO (USA)
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Environmental assessment of a waste-to-energy process: Braintree municipal incinerator, 6:17362 (PB—80-219421)
Environmental assessment of a waste-to-energy process: Burlington Electric's wood and oil co-fired boiler, 6:16800 (PB—80-220627)
Minnesota Univ., Minneapolis (USA)
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
Polarization in inclusive lambda production, 6:17628 (DOE/ER/01764—397)
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Heavy quarks and new particles, 6:17674 (DOE/ER/01764—382)
Missouri Univ., Rolla (USA). Dept. of Electrical Engineering
Research support for plasma diagnostics on Elmo Bumpy Torus: investigation of diamagnetic diagnostics for the electron rings, 6:17770 (ORNL/Sub—7676/1)
Mitre Corp., McLean, VA (USA). METREK Div.
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
Molzen-Corbin and Associates, Inc., Albuquerque, NM (USA)
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Economic analysis of non-taxed commercial solar hot water systems and combined heating and hot water systems, 6:16689 (ANL-K—80-44)
Economic analysis of residential and commercial solar heating and hot water systems, 6:16691 (ANL-K—80-59)
Economic analysis of residential combined solar-heating and hot-water systems, 6:16629 (ANL-K—80-63)
Economic analysis of residential solar water heaters, 6:16692 (ANL-K—80-68)

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Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16536 (GJBX—29(80)(Pt.7))
Hydrogeochemical and stream sediment reconnaissance basic data for Dodge City NTMS Quadrangle, Kansas, 6:16538 (GJBX—77(81))
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Application of coal petrography to the evaluation of magnetically separated dry crushed coals, 6:16444 (CONF-810203—7)
Application of Weibull Criterion to failure prediction in compsites, 6:17215 (Y—2235)
Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)
AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)
Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
Comparison of 50-year and 70-year internal-dose-conversion factors, 6:17744 (ORNL/TM—7415)
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
Coupled operation of the Oak Ridge isochronous cyclotron and the 25 MV tandem, 6:17272 (CONF-810314—82)
3-D nonlinear calculations of resistive tearing modes, 6:17771 (ORNL/TM—7132)
Description of district heating: US history and current status, 6:17041 (CONF-810343—1)
Design studies of an aluminum first wall for INTOR, 6:17828 (BNL—29190)
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
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Environmental decontamination, 6:17401 (CONF-791234—)
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Ion extraction and optics in three dimensions, 6:17838 (ORNL/TM—7691)
Mathematical foundations of LEAP, 6:16890 (ORNL—5754)
Measurement of neutron-transmission spectra through ^{232}Th from 8 MeV to 4 keV, 6:17734 (ORNL/TM—7661)
Measurement of transient two-phase flow velocity using statistical signal analysis of impedance probe signals, 6:17225 (CONF-810434—2(Draft))
Microcomputer-controlled remote pipetter: design and evaluation of a prototype system, 6:17158 (ORNL/TM—7608)
Modeling of phase-change processes with time-varying critical temperature, 6:16880 (ORNL/CSD/TM—145)
Modeling solid hydrogen storage beds, 6:16601 (ORNL/TM—7561)
Moving boundary storm surge modelling with numerical methods, 6:17431 (ORNL—5611)
Neutronic calculations for the conceptual design of an in-reactor solid breeder experiment, TRIO-01, 6:17839 (ORNL/TM—7758)
Novel method for controlled oxidation, 6:16395 (CONF-810308—10)
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Photosynthetic water splitting, 6:16593 (CONF-810345—1)
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Procedure and device for illuminating a three-dimensional area with a radiation beam, 6:16551 (ORNL-tr—4734)
Recent developments in the analysis of air samples by luminescence techniques, 6:17350 (CONF-810346—1)
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Survey, applications, and prospects of Johnson noise thermometry, 6:17325 (CONF-810437—1)
Symposium on molecular and cellular mechanisms of mutagenesis, 6:17530 (CONF-810428—(Absts.))
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Thorium resonance-neutron capture (2.6 to 10 keV), 6:17735 (ORNL/TM—7732)
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US-Japan Workshop on atomic-collision data for fusion, 6:17773 (ORNL/TM—7675)
Variational moment solutions to the Grad-Shafranov equation, 6:17772 (ORNL/TM—7616)
White Oak Creek Watershed topographic map and related materials, 6:17544 (ORNL/TM—7289)
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Evaluation of the physical properties of monodisperse and heterodisperse aerosols used in the assessment of bronchial function, 6:17503 (UR—3490-1977)
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Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
Application of areal seismics to mapping sandstone channels, 6:16511 (SAND—81-0387C)
Applications of reservoir simulation to in situ coal gasification, 6:16386 (SAND—80-2579)
Applications of scanning electron microscopy to failure analysis in ceramics and glasses, 6:17125 (SAND—81-0063C)
Chemical vapor deposition of boron at low temperatures, 6:17144 (SAND—81-0475C)
Commercial applications of overlay coating techniques, 6:17077 (SAND—81-0570C)
Crater: a computer code for calculating late stage crater formation, 6:17341 (SAND—80-1694)
Dynamics of vaporization and dissociation during transient surface heating, with application to vacuum arcs, 6:17800 (SAND—81-0116)
Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)
Geology of magma systems: background and review, 6:16728 (SAND—80-1959)
Geopressured geothermal drilling and completions technology development needs, 6:16743 (SAND—81-0021)
Geothermal drilling and completion technology development program plan, 6:16758 (SAND—81-0380)
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Guy cable design and damping for vertical axis wind turbines, 6:16782 (SAND—80-2669C)
Hydraulic-fracture propagation in layered rock: experimental studies of fracture containment, 6:16519 (SAND—80-2219C)
Hydrocarbon plasma emission as a means to monitor plasma polymerization, 6:17131 (SAND—81-0806C)
Instrumentation and process control development for in situ coal gasification, 6:16388 (SAND—80-2878)
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Laboratory investigation on the effect of in situ stresses on hydraulic fracture containment, 6:16520 (SAND—80-2307C)

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Measurement of magnetically insulated line voltage using a Thomson Parabola Charged Particle Analyser, 6:17881 (SAND—80-2685C)
Midtemperature Solar Systems Test Facility predictions for thermal performance based on test data: Custom Engineering trough with glass reflector surface and Sandia-designed receivers, 6:16716 (SAND—80-1964/10)
Model for the high-frequency electrical response of reservoir rocks and its application to dielectric-log interpretation, 6:16510 (SAND—81-0371C)
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Operating experience at the Central Receiver Test Facility (CRTF), 6:16717 (SAND—80-2504C)
Parameter estimation in structural dynamics models, 6:17211 (SAND—80-0135)
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas, 6:17442 (SAND—80-2573)
Process for producing shale oil by in-situ electrothermal pyrolysis in a shale deposit, 6:16528 (SAND—81-6001)
Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)
Recent developments in numerical ODES, 6:17898 (SAND—81-0013)
Recent developments in polycrystalline diamond-drill-bit design, 6:16754 (SAND—79-1592C)
Report on a workshop on transportation-accident scenarios involving spent fuel, 6:16556 (SAND—80-2012)
Role of site characteristics in the control of underground coal gasification, 6:16387 (SAND—80-2664)
Thermal-fatigue testing of coatings for fusion-reactor applications, 6:17108 (SAND—80-2431C)
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Comparison of DOE-2 and TRNSYS solar-heating-system simulation, 6:16705 (SERI/TR—721-822)
Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)
General solar energy information user study, 6:16628 (SERI/TR—751-753)
Industrial and agricultural process heat information user study, 6:16707 (SERI/TR—751-751)
Ocean energy researchers information user study, 6:16687 (SERI/TR—751-752)
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Photovoltaics: solar electric power systems, 6:16675 (SERI/SP—433-487)
Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications, 6:16633 (SERI/TP—731-1128)
Solar energy storage researchers information user study, 6:16726 (SERI/TR—751-793)
Solar thermal cost goals, 6:16630 (SERI/TR—633-1063)
Status of current IPH applications, 6:16704 (SERI/TP—632-1123)
Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)
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MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Spent fuel dry storage technology development: report of consolidated thermal data, 6:16554 (DOE/NV/00597—6)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.
Feasibility of recycling thorium in a fusion-fission hybrid/PWR symbiotic system, 6:17833 (DOE/ET/51010—9)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center
High-temperature, solid oxide electrolyte fuel cell power generation system. Quarterly report, June 1, 1980-August 31, 1980, 6:16949 (DOE/ET/17089—T1)
WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9. Second annual report, January 1-December 31, 1980, 6:17099 (DOE/ET/13513—T9)
Westinghouse Hanford Co., Richland, WA (USA)
Quality engineering in FFTF irradiation tests, 6:16842 (HEDL-SA—2200)
Westinghouse Research and Development Center, Pittsburgh, PA (USA)
Contract WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9, second annual report, January 1-December 31, 1980, 6:17098 (DOE/ET/13513—T8)
Development of copper sulfide/cadmium sulfide thin-film solar cells, 6:16660 (SERI/PR—8143-1-T3)
Emerging material systems for solar-cell applications. Technical progress report No. 3, 17 October 1979-16 January 1980, 6:16641 (DOE/ET/23003—3)
Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978, 6:16798 (PB—80-219249)
Experimental/engineering support for EPA's FBC program: final report. Volume III. Solid residue study. Final report, January 1977-December 1978, 6:16799 (PB—80-219256)
Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980, 6:16644 (DOE/ET/23106—4)
Silicon materials task of the Low-Cost Solar Array Project: Phase IV. Effects of impurities and processing on silicon solar cells. Twenty-first quarterly report, October-December 1980, 6:16645 (DOE/JPL/954331—81/13)
West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography
Geochemistry studies in Eastern Kentucky. Final report, 6:16464 (DOE/ET/12138—T3)
Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report, 6:16463 (DOE/ET/12138—T2)
Wilson (J.W.) and Associates, Inc., Washington, DC (USA)
Automatic and discretionary adjustment procedures for electric utility rates. Volume II. Final report, 6:16935 (PB—80-208978)
Wisconsin Univ., Madison (USA)
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1980-December 31, 1980, 6:16807 (DOE/ET/29185—19)
Assessment of research directions for high-voltage direct-current power systems. Quarterly technical progress report, July 1-September 30, 1980, 6:16806 (DOE/ET/29185—18)
Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647
Wisconsin Univ., Madison (USA). Dept. of Mechanical Engineering
Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978, 6:17384 (PB—80-205792)
Woodward-Clyde Consultants, San Francisco, CA (USA)
Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)

Y

Yale Univ., New Haven, CT (USA)
Studies of the hydrogenation of small unsaturated molecules using organometallic cluster compounds as catalysts, 6:16604 (DOE/ER/04900—1)
Yale Univ., New Haven, CT (USA). Dept. of Epidemiology and Public Health
Seasonal variations in light scattering in the New York region and their relation to sources, 6:17349 (BNL—29271)
Young (Arthur) and Co., Sacramento, CA (USA)
Analysis of financial incentives for biomass energy. Final report, 6:16651 (P—500-81-002)

AUTHOR INDEX

Authors' surnames are indexed in the form appearing in the abstracted publication; given names are reduced to initials. Each author entry gives the publication title and the citation number. Report numbers, if applicable, are given in parentheses at the end of the entry. For publications with multiple authors, an author entry is provided for each. Entries for the second and succeeding authors give references to the first author.

Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. Changes in spelling introduced as a result of accent omission follow standard conventions.

A

Abbott, L.F., *See* Wise, M.B., 6:17664

Abel, J.A., *See* Szedon, J.R., 6:16660

Abey, A.E., *See* Durham, W.B., 6:17554

Abou-Sayed, I.S., *See* Kanninen, M.F., 6:16849

Ache, H.J., Reactions of charged and neutral recoil particles following nuclear transformations. Final report, 6:17200 (ORO—3602-21)

Achey, P.M., Photoreactivation of pyrimidine dimers in DNA from thyroid cells of the teleost, Poecilia formosa, 6:17522

Ackerman, C.D., Slurry-letdown and isolation-valve performance at the Fort Lewis SRC Pilot Plant, 6:16361 (DOE/MC/14522—1, pp 8.1-8.10)

Ackerman, D.G., Health impacts, emissions, and emission factors for noncriteria pollutants subject to de minimis guidelines and emitted from stationary conventional combustion processes, 6:17369 (PB—80-221237)

Ackerman, F.J., Oil shale project small retort run summary, Run S-15. Addendum. Computer tables, 6:16526 (UCID—18282(Rev.1))

Adachi, M., Feasibility of closed Fe(II)/Fe(III) system for product-reflux in Nitrox process, 6:17165 (DOE/ER/10612—2)

Adams, J.C., *See* Osborn, A.G., 6:17336

Adams, S.M., Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)

Guidance for use of experimental systems to evaluate effects of stress in marine ecosystems, 6:17425 (ORNL/TM—7644)

Adams, S.S., Geology and recognition criteria for uraniferous humate deposits, Grants Uranium Region, New Mexico. Final report, 6:16533 (GJBX—2(81))

See Button, A., 6:16531

Adelstein, S.J., Development and therapeutic application of internally emitting radiopharmaceuticals, 6:17197 (DOE/EV/04115—4, pp 54-64)

Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981, 6:17192 (DOE/EV/04115—4)

See Bloomer, W.D., 6:17514

Aguilar, F., *See* Spore, J.W., 6:16862

Ahlquist, A.J., LASL experience in decontamination of the environment, 6:17404 (CONF-791234—, pp 46-60)

Ahmad, S., Fission yields and lifetimes for muon induced fission in ^{235}U and ^{238}U, 6:17736

Ahmed, M., *See* Kennish, W., 6:16959

Ahmed, M.M., *See* Ciliberti, D.F., 6:16798

Ahner, D.J., Moving-bed gasification - combined-cycle control study. Volume 1: results and conclusions, Case 1 - air-blown dry-ash operation. Final report, 6:16374 (EPRI-AP—1740(Vol.1))

Aiman, W.R., Reverse combustion in a borehole, 6:16391

Akin, J.E., *See* Wooten, J.W., 6:17838

Akkermans, J.M., *See* Gruppelaar, H., 6:17713

Al-Alami, M.Z., *See* Kiefer, J.H., 6:17626

Alberi, G., Deuteron D-wave and the non-eikonal effects in tensor asymmetries in elastic proton-deuteron scattering, 6:17687

Albers, R.C., Self-consistent phonon approximations for the solid phase of a one-component plasma, 6:17751

Alde, D.M., Search for parity non-conservation polarized proton-nucleon scattering at 6 GeV/c, 6:17650

Aldrich, J.M., Evaluate existing radiation fields, 6:17311 (PNL—3536, pp 6.1-6.30)

See Endres, G.W.R., 6:17305, 6:17306, 6:17307

Aldrich, J.W., *See* Kathren, R.L., 6:17314

Alessi, J., Development of multiampere negative ion sources, 6:17827 (BNL—29159)

Alexiades, V., Modeling of phase-change processes with time-varying critical temperature, 6:16880 (ORNL/CSD/TM—145)

Alison, D.R., Geologic and engineering data acquisition for underground coal mine ground control. Contract research report, January 1976-November 1979, 6:16431 (PB—80-219272)

Alkhafaji, S., *See* Magid, L.J., 6:16465

Allen, R.P., New decontamination technologies for environmental applications, 6:16581 (CONF-791234—, pp 110-122)

Allinger, J.E., Tests of a 3 meter curved superconducting beam transport dipole magnet, 6:17263 (BNL—29174)

Allison, C.E., Job and task analysis: a view from the inside, 6:16821 (CONF-810411—, pp 142-153)

Almgren, M., Interfacial electron transfer involving radical ions of carotene and diphenylhexatriene in micelles and vesicles, 6:17190

Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study, 6:17191

Alquist, L.J., *See* Talbert, W.L. Jr., 6:17715

Alston, T.G., Implementation planning for industrial energy conservation: approach and methodology, 6:16987 (ANL/CNSV-TM—55)

Althouse, L.P., *See* Hoffman, D.M., 6:17133

Altstetter, C., *See* de Avillez, R., 6:17085

Alvarez, I., *See* Mayo, M., 6:17576

Alvarez, M., *See* Ward, P.F., Smith, K.D., Vann, L.G. Jr., 6:16651

Alvin, M.A., *See* Ciliberti, D.F., 6:16798

An, C.H., High-n ballooning modes in highly elongated tokamaks, 6:17818

Ananth, K., *See* Golembiewski, M., 6:17362

Ander, M.E., Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau, 6:16737 (LA—8676-T)

Anderson, A.C., *See* Katerberg, J.A., 6:17113

See Walker, F.J., 6:17129

Anderson, A.W., Increasing the value of straw by fermentation, 6:16652 (PB—80-207939)

Anderson, C.J., *See* Anderson, L.W., 6:17589

Anderson, D.M., Electronic weighing, identification and subdermal body temperature sensing of range livestock, 6:17511 (LA-UR—81-748)

Anderson, D.V., Calculation of ideal MHD growth rates and eigenfunctions in field reversed mirrors in the large toroidal mode number limit, 6:17781 (PPPL—1755, pp 82-85)

See Barnes, D.C., 6:17787

Anderson, L.W., Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304, pp 285-290)

Andrews, L.C., Improved crystal and molecular structure of guanidinium hydrogen oxalate monhydrate, $C(NH_2)_3HC_2O_4.H_2O$, 6:17184

Angel, J.R.P., *See* Szkody, P., 6:17564

Angelo, J.A. Jr., *See* Buden, D., 6:16859

Annis, B.K., *See* Haywood, S.E., 6:17619

Antal, M.J. Jr., Biomass energy enhancement, 6:16649

App, M.J., *See* DeWerth, D.W., 6:16972

Arbesman, R.W., Modeling in peat gasification, 6:16612 (TR—80/031-001, pp 247-270)

Archuleta, J., *See* Potter, R.M., 6:17324
Arens, E.A., Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final), 6:16973 (PB—80-213424)
Armen, G.H., *See* Feldberg, S.W., 6:17470
Armentrout, P.B., Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O, 6:17618
Armstrong, D.L., *See* Gardner, J.F., 6:16446
Armstrong, R.W., *See* Storti, G., 6:16662
Armstrong, W.T., Field reversal experiments: FRX-A and FRX-B results, 6:17785 (PPPL—1755, pp 102-105)
Observations of plasma tearing instabilities and associated axial translation in field-reversed experiments, 6:17765 (LA—8729-MS)
See Linford, R.K., 6:17843
Arnold, G., Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Arons, R.M., *See* Pierce, R.D., 6:16946
Arrowsmith, H.W., *See* Allen, R.P., 6:16581
Arthurs, M.J., Westinghouse fluidized-bed gasification process and valve requirements, 6:16363 (DOE/MC/14522—1, pp 12.1-12.16)
Ashare, E., *See* Levy, P.F., 6:16605
Ashok, S., *See* Temofonte, T.A., 6:16644
Ast, D., *See* Cunningham, B., 6:16647
Ast, D.G., Influence of grain boundaries on the electrical properties of polycrystalline-silicon films. Progress report, 1980-1981, 6:17140 (DOE/ER/02899—T2)
Atkinson, L.P., Continental shelf processes affecting the oceanography of the South Atlantic Bight. Progress report, 1 June 1980-1 June 1981, 6:17555 (DOE/EV/00889—7(Vol.1))
First preliminary report of the GABEX-1 cruises: station logs, standard sections and maps and time series transects, 6:17556 (DOE/EV/00889—7(Vol.2))
See Singer, J.J., 6:17557
Atwood, W.B., Time-of-flight measurements, 6:17320 (SLAC—239, pp 287-308)
Auerbach, S.P., Two dimensional time-dependent transport in field reversed equilibria, 6:17780 (PPPL—1755, pp 76-79)
Augustine, F., Economics of four FGD systems. Final report, 6:16794 (EPRI-CS—1677)
Ausherman, D.A., *See* Shwartz, J., 6:17220
Ausmus, B.S., *See* Kitchell, J.F., 6:17399
Avery, J.G., *See* Grimmer, D.P., 6:16712
Avignone, F.T. III., High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report, 6:17723 (DOE/ER/10434—2)
See Ritchie, B.G., 6:17730
Aydemir, A., Two-dimensional simulation of the formation of the PPPL spheromak, 6:17866 (PPPL—1755, pp 176-179)
Ayers, A.C., *See* Kandil, H.M., 6:17151

B

Baalman, R.W., Analysis of criticality safety, 6:17508 (PNL—3700(Pt.5), pp 69-70)
Analysis of fusion fuel cycles, 6:17460 (PNL—3700(Pt.5), pp 45-48)
Analysis of nuclear fuel cycles, 6:17459 (PNL—3700(Pt.5), pp 39-43)
Compressed air energy storage (CAES), 6:17458 (PNL—3700(Pt.5), pp 37)
DOE decommissioning criteria development, 6:17461 (PNL—3700(Pt.5), pp 53-55)
Environmental control technology for shale oil wastewaters, 6:17456 (PNL—3700(Pt.5), pp 31-33)
Environmental data reporting system, 6:17446 (PNL—3700(Pt.5), pp 61)
Environmental protection support, 6:17462 (PNL—3700(Pt.5), pp 57)
Geothermal liquid waste disposal, 6:17457 (PNL—3700(Pt.5), pp 35-36)
Handbooks on effluent and environmental monitoring, 6:17385 (PNL—3700(Pt.5), pp 59)
Health physics lead laboratory, 6:17507 (PNL—3700(Pt.5), pp 65-68)
Liquefied natural gas (LNG) safety studies, 6:17454 (PNL—3700(Pt.5), pp 21-23)
Liquefied petroleum gas (LPG) research assessment, 6:17455 (PNL—3700(Pt.5), pp 29-30)
Oil spills, 6:17438 (PNL—3700(Pt.5), pp 25-28)
Personnel dosimetry calibrations, 6:17506 (PNL—3700(Pt.5), pp 63-64)
Radioisotope customer list, 6:17510 (PNL—3700(Pt.5), pp 77)
Regional impacts, 6:17377 (PNL—3700(Pt.5), pp 11-16)
Regulatory analysis, 6:17421 (PNL—3700(Pt.5), pp 1)
Statistical health-effects study, 6:17509 (PNL—3700(Pt.5), pp 75-76)
Technology assessment, 6:17453 (PNL—3700(Pt.5), pp 3-9)
Babad, H., Method for immobilizing radioactive iodine, 6:16574
Bacal, M., Cesium supersonic jet for D^- production by double electron capture, 6:17588 (BNL—51304, pp 270-281)
H^- and D^- production in plasma, 6:17575 (BNL—51304, pp 95-105)
See Hamilton, G.W., 6:17574
Bacca, J.P., Post-irradiation handling and examination at the HFEF complex, 6:16856 (CONF-800592—9)
Bachrach, R.Z., *See* Hansson, G.V., 6:17330
Backe, H., *See* Wohlfarth, H., 6:17728
Bader, B.E., Role of site characteristics in the control of underground coal gasification, 6:16387 (SAND—80-2664)
Bailey, V., Intense relativistic electron beams in toroidal magnetic geometries, 6:17846 (PPPL—1755, pp 26-28)
Bailey, W.F., Production of negative ions under non-equilibrium conditions, 6:17570 (BNL—51304, pp 33-41)
Baishiki, R., *See* Benson, P., 6:17367
Baker, D.A., Toroidal reversed field-pinch experiments, 6:17856 (PPPL—1755, pp 86-88)
Baker, L., Heuristic model of the nonlinear Rayleigh-Taylor instability, 6:17759
Baker, R.W., *See* Hewson, E.W., 6:16764, 6:16765, 6:16766
Baker, S.P., Application of a vortex shedding flowmeter to the wide range measurement of high temperature gas flow, 6:16865 (CONF-810434—3)
Baladi, E., *See* Golembiewski, M., 6:17362
Ball, J.B., *See* Lord, R.S., 6:17272
Balluffi, R.W., *See* Brokman, A., 6:17090, 6:17747
Baltz, A.J., Spiral design and beam dynamics for a variable energy cyclotron, 6:17251 (BNL—29201)
Bamberger, C.E., Thermochemical cyclic system for decomposing H_2O and/or CO_2 by means of cerium-titanium-sodium-oxygen compounds, 6:16597
Barbier, M.M., Machine technology: a survey, 6:17420 (CONF-791234—, pp 243-253)
Barchet, W.R., *See* Freeman, D.L., 6:16767
See Paton, D.L., 6:16768
See Wise, J.L., 6:16769
Bard, C.S., *See* Butz, T.R., 6:16535, 6:16536
Bardsley, J.N., Production and destruction of H^- and D^- ions in hydrogen or deuterium plasmas, 6:17568 (BNL—51304, pp 10-14)
Barish, B., Recent results from the CFRR neutrino experiment at Fermilab, 6:17629 (DOE/ER/02232—97)
Recent results from the CFRR neutrino experiment at Fermilab, 6:17636 (SLAC—239, pp 475-486)
Barker, R.E., *See* Doman, D.R., 6:17206
Barnes, D.C., Compact torus theory: MHD equilibrium and stability, 6:17787 (PPPL—1755, pp 110-114)
See Anderson, D.V., 6:17781
Barnes, L.W., *See* Mehrhoff, T.K., 6:17234
Baron, J., *See* Nawrocky, R.J., 6:17293
Barr, S., *See* Davis, C.G., 6:17353
Barrett, R.E., Preliminary environmental assessment of afterburner combustion systems. Final report, March 1977-June 1980, 6:17245 (PB—80-215734)
Bartell, S.M., *See* Kitchell, J.F., 6:17399
Bartholomew, C.H., Investigation of carbon deposition on fluidized methanation catalysts. Appendix, 6:16355 (DOE/ET/14815—20, pp 83-144)
See Mustard, D.G., 6:17172
Bartholomew, J.C., *See* Parry, G., 6:17486
Barton, J.P., Fluctuations in combustion-driven MHD generators, 6:16943 (DOE/ET/15611—1)
Bartsch, R.R., *See* Linford, R.K., 6:17843
Basaran, M., *See* Schmid, F., 6:16646
Basile, R.J., Selection and experience to date with block valves for the Exxon Coal-Liquefaction Pilot Plant, 6:16360 (DOE/MC/14522—1, pp 7.1-7.8)
Bass, A., *See* Paton, D.L., 6:16768
Bassham, J.A., *See* Macler, B.A., 6:17479
Bastius, H., *See* Teynen, P., 6:17167
Basu, B., Theory of m = 1 modes in collisionless plasmas, 6:17804
Batchelor, K., R.F. cavity design for the NSLS, 6:17269 (BNL—29226)
Bateman, G., *See* An, C.H., 6:17818
Bates, F.J., Laser fusion systems for industrial process heat. Final report, 6:17834 (DOE/TIC—11435(Vol.1))
Laser fusion systems for industrial process heat. Final report, 6:17835 (DOE/TIC—11435(Vol.2))
Bates, J., Ceramic component for electrodes, 6:16944

Batycky, J.P., Towards understanding wettability effects on oil recovery, 6:16473 (CONF-8004140—, pp 116-143)
Baum, J.W., *See* Kale, P., 6:17528
Baumeister, P., *See* Edwards, D.F., 6:17328
Baylor, V.B., Stress-corrosion cracking studies in coal-liquefaction systems, 6:16345 (CONF-810402—9)
Bazan, C., *See* Hoenig, C., 6:16571
Beard, J.N. Jr., Optimization of energy usage in textile finishing operations. Part I. The simulation of batch dyehouse activities with a general purpose computer model, 6:17035 (DOE/CS/40092—T1)
Beattie, W.H., Flash pyrolysis of coal through solar heating, 6:16378 (LA-UR—81-764)
Beauchamp, J.L., *See* Armentrout, P.B., 6:17618
Beavers, J.A., *See* Rosenberg, H.S., 6:16406, 6:16795
Beck, C.A., Hydroelectric power in Hawaii. A report on the statewide survey of potential hydroelectric sites, 6:16617 (DOE/R9/10031—T1)
Becker, R. Jr., *See* Wise, J.L., 6:16769
Beckers, R.M., *See* Lord, R.S., 6:17272
Beckman, R., Economic evaluation of coal gasification for electric power generation (an update). Final report, 6:16373 (EPRI-AP—1725)
Beckman, R.J., *See* Johnson, M.E., 6:16548
Bederson, B., Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)
Bedwell, B., *See* Magid, L.J., 6:16465
Beer, G.A., *See* Ahmad, S., 6:17736
Behrens, J.W., *See* Johnson, R.G., 6:17275
Behrmann, R.B., *See* Neumann, H.J., 6:16472
Belew, W.W., General solar energy information user study, 6:16628 (SERI/TR—751-753)
Industrial and agricultural process heat information user study, 6:16707 (SERI/TR—751-751)
Ocean energy researchers information user study, 6:16687 (SERI/TR—751-752)
Solar energy storage researchers information user study, 6:16726 (SERI/TR—751-793)
Bell, A.T., *See* Kellner, C.S., 6:17181
Bell, J.A., *See* Feldberg, S.W., 6:17470
Bell, J.R., Fire protection at the Fast Flux Test Facility (a sodium cooled test reactor), 6:16857 (HEDL-SA—1985)
Bell, N.B., *See* Scheld, H.W., 6:16659
Bell, W.K., *See* Holmes, J.T., 6:16717
Bellmore, J.R., *See* Blue, L.A., 6:16831
Bement, T.R., *See* Johnson, M.E., 6:16548
Benford, J., *See* Bailey, V., 6:17846
Benham, C., *See* Bohn, M., 6:16661
Benjamin, B.M., Novel method for controlled oxidation, 6:16395 (CONF-810308—10)
Bennett, E.L., *See* Lukas, R.L., 6:17478
Benson, D.A., Dynamics of vaporization and dissociation during transient surface heating, with application to vacuum arcs, 6:17800 (SAND—81-0116)
Benson, P., CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Model-simulation, 6:17367 (PB—80-220833)
Benson, P.E., CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Interim report, 6:17368 (PB—80-220841)
Benson, S., *See* Miller, C.W., 6:16753
Berg, G.P.A., *See* Rullhusen, P., 6:17710
Berg, W.W., First measurements of total chlorine and bromine in the lower stratosphere, 6:17566
Berger, E.L., Inelastic photoproduction of J/psi and Y by gluons, 6:17663
Bergstroem, J.B., *See* Foucher, J.L., 6:17593
Berk, H.L., Tearing-mode stability analysis of a cylindrical plasma, 6:17789 (PPPL—1755, pp 122-125)
See Auerbach, S.P., 6:17780
See Hammer, J.H., 6:17855
Berman, B.L., *See* Browne, J.C., 6:17721
Berry, H.G., *See* Gay, T.J., 6:17605, 6:17606
Berry, L., *See* Hirst, E., 6:16962
Bertin, A., *See* Frehaut, J., 6:17718
Bertsche, A., *See* Thompson, P., 6:17295
Bevington, P.R., *See* Cverna, F.H., 6:17644
Bhadra, D., *See* Chu, C., 6:17761
Bhat, M.R., Differential data including dosimetry reactions, 6:17682 (DOE/NDC—21/L(Vol.1), pp 19-29)
FMIT related problems: shielding and materials damage studies, 6:17683 (DOE/NDC—21/L(Vol.1), pp 31-41)
Intense high energy neutron sources and their characteristics, 6:17273 (DOE/NDC—21/L(Vol.1), pp 7-18)
Nuclear model codes and data evaluation, 6:17737 (DOE/NDC—21/L(Vol.1), pp 43-57)
Symposium on neutron cross-sections from 10 to 50 MeV, 6:17681 (DOE/NDC—21/L(Vol.1))
Symposium on neutron cross-sections from 10 to 50 MeV, v.:17685 (DOE/NDC—21/L(Vol.2))
Bicker, A.E., Site decontamination, 6:17408 (CONF-791234—, pp 91-99)
Biddick, C.J., Bremsstrahlung process in electron positron colliding beams, 6:17651
Biefeld, R.N., *See* Carling, R.W., 6:16680
Bieg, K.W., Hydrocarbon plasma emission as a means to monitor plasma polymerization, 6:17131 (SAND—81-0806C)
Bienewitz, K.H., *See* Mischke, H., 6:16912
Bilello, J.C., *See* Liu, J.M., 6:17298
Bingham, C.R., Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)
Bingham, G., *See* Twiss, R., 6:16745
Binns, D.R., Aqueous carbonate process test requirements document. Final report, 6:16407 (EPRI-CS—1738)
Birchenall, A.K., *See* Sakurai, T., 6:17082, 6:17093
Birget, C.D., *See* Ophaug, R.A., 6:17008
Birkelund, J.R., *See* Hilscher, D., 6:17719
See Mignerey, A.C., 6:17708
Bishop, S.S., *See* Singer, J.J., 6:17557
Bisognano, J., *See* Lambertson, G., 6:17260
Bissell, M.J., *See* Parry, G., 6:17486
Bissell, R.R., *See* Little, N.H., 6:16760
Biter, W.J., Emerging material systems for solar-cell applications. Technical progress report No. 3, 17 October 1979-16 January 1980, 6:16641 (DOE/ET/23003—3)
See Szedon, J.R., 6:16660
See Temofonte, T.A., 6:16644
Biyikli, S., *See* Chen, J.C., 6:17240
Bjorken, J.D., Electroweak interactions, 6:17656 (FERMILAB-Conf—80/86-THY)
Blackburn, L.D., Mechanical properties of type 316 stainless steel materials after irradiation at 515°C and 585°C, 6:16843 (HEDL-TME—81-4)
Blagun, B., *See* Dunbar, D., 6:17392
Blair, B., *See* Barish, B., 6:17629, 6:17636
Blalock, T.V., Survey, applications, and prospects of Johnson noise thermometry, 6:17325 (CONF-810437—1)
Blankenbecler, R., *See* Wise, M.B., 6:17664
Blegun, B., *See* Dunbar, D., 6:17393
Bleser, E., *See* Wanderer, P., 6:17287
Bleszynski, M., Spin rotation and depolarization in the ^{3}H(p vector,p vector)^{3}H reaction and the double-spin-flip part of the NN amplitude, 6:17689
See Alberi, G., 6:17687
Blewitt, J.P., Free electron laser experiment at the NSLS 700 MeV electron storage ring, 6:17291 (BNL—29209)
Blomquist, W., *See* Chaney, S., 6:17534
Bloom, E.D., Brief review of recent results from the crystal ball detector at SPEAR, 6:17633 (SLAC—239, pp 349-359)
Bloomer, W.D., Astatine-211-tellurium radiocolloid cures experimental malignant ascites, 6:17514
See Adelstein, S.J., 6:17197
Blue, L.A., Health physics training at V.C. Summer Nuclear Station, 6:16831 (CONF-810411—, pp 247-254)
Bluhm, R., Community wind electrical power case study: Muir Beach. Final report, 6:16779 (DOE/SF/01963—T2)
Blumberg, L., *See* Blewitt, J.P., 6:17291
Bockhold, G. Jr., Best nuclear simulator, 6:16815 (CONF-810411—, pp 32-45)
Bodek, I., *See* Santhanam, C.J., 6:16410
Bohn, M., Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)
Bois, R., *See* Frehaut, J., 6:17718
Bolt, J., *See* Frank, H.A., 6:17483
Bonnet, J.M., Standards and procedures for INTERACT, 6:17892 (CONF-810431—1)
Booker, G.R., *See* Sadana, D.K., 6:17150
Boothe, G.F., Surface soil contamination standards for Rockwell Hanford Operations, 6:17412 (CONF-791234—, pp 144-151)
Boozer, A.H., *See* Stewart, L.D., 6:17592
Borek, C., *See* Guernsey, D.L., 6:17519
Borg, I.Y., *See* Briggs, C.K., 6:16955
Borst, W.L., Longterm solar heat storage (abstract), 6:16725 (CONF-810509—1)
Botts, T.E., Means and method for the destruction of particles entrained in a gas stream, 6:16791
Boushell, C.C., Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2), pp 528-534)
Bowman, C.D., *See* Johnson, R.G., 6:17275

Bowman, R.M., Applications of fusion thermal energy to industrial processes, 6:17829 (CONF-801210—24)
Boyarski, A., HANDYPAK: a histogram and display package (release 6.0), 6:17899 (SLAC—234)
Boyd, B.A., *See* Clifford, .D.W., 6:16585
Boyd, D., *See* Hosea, J., 6:17774
Boyd, J.K., *See* Auerbach, S.P., 6:17780
Boykin, W.B., *See* Combes, R.S., 6:16989
Bozoki, E., Status of the National Synchrotron Light Source control system, 6:17266 (BNL—29208)
Bradbury, J., *See* Paciotti, M., 6:17281
Bradford, R. Jr., *See* Homer, M., 6:17523
Bradshaw, R.W., *See* Carling, R.W., 6:16680
Brady, F.P., *See* Subramanian, T.S., 6:17694
See Zanelli, C.I., 6:17702
Brand, H.R., PLTLIB: graphics library for Tektronix 4025 and 4027 terminals, 6:17900 (UCID—18981)
Brandi, R.M., *See* Van Horn, A.J., 6:16797
Brandriff, B., Repair of the ultraviolet-irradiated male genome in fertilized mouse eggs, 6:17516
Brandt, D., UV photoemission from ZrF_4, 6:17154
Branum, D., *See* Reginato, L.L., 6:17282
Brasch, F.M. Jr., Design of multiprocessor structures for simulation of power-system dynamics. Final report, 6:16811 (EPRI-EL—1756)
Braund, S., *See* Ender, R.L., 6:16496
Bray, D.J., *See* McGee, T.D., 6:16370
Brengle, T.A., *See* Cohen, B.I., 6:17854
Bretz, N., *See* Hosea, J., 6:17774
Breuer, H., *See* Hilscher, D., 6:17719
See Mignerey, A.C., 6:17708
Brewer, E.N., DNA synthesis in a sub-nuclear preparation isolated from Physarum polycephalum, 6:17477
Brickman, S.W., Use of a conversational computer program in operator training for improved energy efficiency, 6:17025 (CONF-800483—(Vol.2), pp 766-776)
Brierly, L., *See* Hirsch, E., 6:16771
Briggs, C.K., California energy flow in 1979, 6:16955 (UCID—18991)
Briggs, J., Leak checking in ISABELLE, 6:17262 (BNL—29148)
Briggs, J.J., *See* Schneider, W.J., 6:17294
Briggs, T., *See* Owens, T., 6:16631
Brink, D.F., Solar production of industrial process steam. Phase III. Operation and evaluation of the Johnson and Johnson solar facility. Final report, January 1, 1980-March 31, 1981, 6:16694 (DOE/CS/31713—T1)
Bristowe, P.D., *See* Brokman, A., 6:17090
Brixner, B., Lens design and local minima, 6:17230
Brock, D., *See* Horton, W. Jr., 6:17807
Broders, M.A., Potential for district heating: an historical overview, 6:17042 (CONF-810435—1)
Brodowski, J., *See* Gammel, G., 6:17271
Broek, D., *See* Kanninen, M.F., 6:16849
Brokman, A., Coincidence lattice model for the structure and energy of grain boundaries, 6:17747 (DOE/ER/05002—16)
Computer simulation study of the structure of vacancies in grain boundaries, 6:17090 (DOE/ER/05002—15)
Bromberg, L., Passive thermal-stability control in ignited tokamaks by ripple transport and radial motion, 6:17822
Bronicki, L.Y., *See* Rohrer, J.W., 6:17013
Brooks, A.W., *See* Stoenescu, M.L., 6:16945
Brooman, E.W., *See* Clifford, J.E., 6:16882
Brouwer, J., *See* Ubbels, J., 6:17040
Brower, A.S., *See* Ahner, D.J., 6:16374
Browman, A., LAMPF hardware beam transmission monitor systems, 6:17277 (LA-UR—81-731)
See Sander, O., 6:17258
Brown, B.C., *See* Yamanouchi, T., 6:17643
Brown, C.D., *See* Habegger, L.J., 6:17451
Brown, C.E., *See* Warren, S., 6:17532
Brown, C.N., *See* Yamanouchi, T., 6:17643
Brown, C.T., Applied research in the solar thermal-energy-systems program, 6:16681 (SERI/TP—633-1148)
Brown, D.P., *See* Schneider, W.J., 6:17294
Brown, D.R., *See* Dimachkieh, S., 6:17000
Brown, F.H., *See* Evans, S.H. Jr., 6:16762
Brown, H., New AGS slow external beam switchyard, 6:17264 (BNL—29176)
Brown, J.A., NMR measurements on Western Gas Sands core, 6:16508 (LA-UR—81-736)
See Jackson, J.A., 6:16507
Brown, L.F., *See* Brown, J.A., 6:16508
Brown, R., *See* Brown, H., 6:17264
Brown, R.E., *See* Cizewski, J.A., 6:17729
Brown, S., *See* Meier, P., 6:16893
Brown, W.R., *See* Dutton, J.W., 6:16822
Browne, J.C., Neutron-capture cross sections for osmium isotopes and the age of the universe, 6:17721
Brownell, G.L., Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4, pp 65-124)
See Adelstein, S.J., 6:17192
Brueck, S.R.J., Laser-induced dielectric breakdown in cryogenic liquids, 6:17152
Bruhn, R.L., *See* Yusas, M.R., 6:16727
Bruneteau, A.M., *See* Bacal, M., 6:17575
See Hamilton, G.W., 6:17574
Buckner, A.T., *See* Cady, W.E., 6:17132
Buden, D., Reactors for nuclear electric propulsion, 6:16859 (LA-UR—81-703)
Budinger, T.F., *See* Derenzo, S.E., 6:17491
Buehring, W.A., *See* Whitfield, R.G., 6:16899
Buening, H.J., *See* Carter, W.A., 6:17243, 6:17246
Buivid, M.G., Peat biogasification, 6:16613 (TR—80/031-001, pp 271-286)
Bullett, M.J., *See* Christensen, O.D., 6:16735
Bullwinkel, H.J., Three-year performance study of the Mead, Nebraska, 25-kWp photovoltaic power system, 6:16669 (DOE/ET/20279—122)
Bunch, W.L., *See* Gold, R., 6:16841
Bunker, B.C., *See* Wilder, J.A. Jr., 6:17124
Bunker, S.S., *See* Davis, C.G., 6:17353
Buras, A.J., Seven topics in perturbative QCD, 6:17677 (FERMILAB-CONF—80/79-THY)
Burk, R.L., Oxygen isotope ratios in trees reflect mean annual temperature and humidity, 6:17517
Burke, J.E., *See* Twiss, R., 6:16745
Burkhardt, F.R., Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980, 6:16793 (DOE/GFETC/10059—2)
Burnham, M.W., Assessment of available small deep hole inspection methods, 6:17228 (RFP—3198)
Burrs formed in producing small holes, 6:17107 (RFP—3195)
Burns, A.B., Energy use management: one company's story, 6:17020 (CONF-800483—(Vol.2), pp 712-717)
Burns, D.J., *See* Gay, T.J., 6:17605
Busacca, P.A., *See* Brewer, E.N., 6:17477
Busby, J.F., *See* Campbell, J.H., 6:16418
Bush, E., *See* Sander, O., 6:17258
Bushey, R.W., *See* Squires, B.T., 6:17359
Busing, W.R., WMIN: a computer program to model molecules and crystals in terms of potential energy functions, 6:17169 (ORNL—5747)
Buth, L., *See* Cierjacks, S., 6:17725
Butt, J.B., Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Button, A., Geology and recognition criteria for uranium deposits of the quartz-pebble conglomerate type. Final report, 6:16531 (GJBX—3(81))
Button, J.W., Laboratory evaluation of selected tar sand asphalts, 6:16529 (DOE/LC/10049—T1)
Butz, T.R., Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16535 (GJBX—29-80(Pt.6))
Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16536 (GJBX—29(80)(Pt.7))
Buzzi, J.M., *See* Bacal, M., 6:17588

C

Cadoff, L.H., *See* Sadler, J.W., 6:16942
Cady, W.E., Effect of vinyl and phenyl contents of silicone gum on the properties of the elastomers and cellular silicone cushions, 6:17132 (UCRL—53105)
Cahill, A.L., Chronotypic induction of tyrosine aminotransferase by α-methyl-p-tyrosine, 6:17471
Cahoon, J.L., *See* Derenzo, S.E., 6:17491
Cain, W.D., Application of Weibull Criterion to failure prediction in compsites, 6:17215 (Y—2235)
Calvin, M., Petroleum plantations for fuel and materials, 6:16665
Camaioni, D.M., *See* Franz, J.A., 6:17183
Cameron, G.N., *See* Scheld, H.W., 6:16659
Campbell, D.K., Tunneling decay of unstable particles in a quantum field theoretic model, 6:17679
Campbell, J.H., Groundwater quality near an underground coal gasification experiment, 6:16418
Campbell, K., *See* Johnson, M.E., 6:16548
Campbell, S., For 110, the fine Avondale mine was a tomb, 6:16443
Campillo, A.J., *See* Blewitt, J.P., 6:17291
Canfield, D.R., *See* Ackerman, C.D., 6:16361
Cannon, T.M., Mosaic of coded aperture arrays, 6:17231

Caplinger, W.H., Quality engineering in FFTF irradiation tests, 6:16842 (HEDL-SA—2200)
Caputo, A.J., Method of evaluating the integrity of the outer carbon layer of triso-coated reactor fuel particles, 6:16552
Caramana, E.J., Effects of impurity radiation on reversed-field pinch evolution, 6:17784 (PPPL—1755, pp 98-101)
Effects of impurity radiation on reversed-field pinch evolution, 6:17817
Carfagno, D.G., *See* Farmer, B.M., 6:17441
Carhart, R., *See* Policastro, A., 6:17351
Carley, J.F., *See* Ackerman, F.J., 6:16526
Carling, R.W., Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Carlson, D.H., *See* Johnson, J.H., 6:16429
Carlson, G.A., Fusion component design for the moving-ring field-reversed mirror reactor, 6:17883 (UCID—18916)
Neutral beam sustained, field-reversed mirror reactors, 6:17876 (PPPL—1755, pp 220-223)
Tandem mirror reactor studies at Lawrence Livermore National Laboratory, FY 1980, 6:17885 (UCID—18989)
See Smith, A.C. Jr., 6:17877
Carmichael, J.D., Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 1. Body of report, 6:16482 (DOE/ET/12047—52(Vol.1))
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 2. Appendix I, 6:16483 (DOE/ET/12047—52(Vol.2))
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 3. Appendices II-XVII, 6:16484 (DOE/ET/12047—52(Vol.3))
Carne, T.G., Guy cable design and damping for vertical axis wind turbines, 6:16782 (SAND—80-2669C)
See Clauss, D.B., 6:16781
Carney, G.D., Spectroscopic B/sub v/ constants for Rydberg states of D_3, 6:17621
Carney, J.H., SEAP: a computer program for the error analysis of a stream model, Monte Carlo methodology and program documentation, 6:17432 (ORNL/TM—7654)
Carpenter, H.J., Recommended research on LNG safety, 6:16512 (DOE/EV/10024—1)
Carpenter, K.H., Research support for plasma diagnostics on Elmo Bumpy Torus: investigation of diamagnetic diagnostics for the electron rings, 6:17770 (ORNL/Sub—7676/1)
Carpenter, L.K., *See* Nakaishi, C.V., 6:16368
Carr, R., Rheology of suspensions of normal and hardened erythrocytes and their mixtures, 6:17504
Carreras, B., *See* Hicks, H.R., 6:17771
Carroll, A.S., *See* Allinger, J.E., 6:17263
Carter, A.B., CP violation in B-meson decays, 6:17673
Carter, H.K., *See* Ritchie, B.G., 6:17730
Carter, J.A., *See* Donohue, D.L., 6:17160
Carter, W.A., Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)
Carvetti, J., *See* Dunbar, D., 6:17392
Casarett, G.W., Low-level radioactive biomedical wastes, 6:16577 (UR—3490-1978)
Cason, C.L., *See* Mathewson, C.C., 6:16415
Castaldini, C., *See* Lim, K.J., 6:16801
See Lim, K.L., 6:17244
Castaneda, C.M., *See* Zanelli, C.I., 6:17702
Catto, P.J., Omnigenous equilibria, 6:17799 (SAI—254-81-102-LJ)
Cavagnaro, D.M., Air quality monitoring. 1977-1978 (citations from the NTIS data base). Report for 1977-78, 6:17374 (PB—80-813462)
Air quality monitoring. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980, 6:17375 (PB—80-813470)
Fuel cells. 1977-1978 (citations from the NTIS data base). Report for 1977-78, 6:16953 (PB—80-813389)
Fuel cells. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980, 6:16954 (PB—80-813397)
Pollution caused by ammunition manufacturing. 1964-July 1980 (citations from the NTIS data base). Report for 1964-July 1980, 6:17376 (PB—80-814478)
Cawby, R.D., CMS plotter graphics training manual, 6:17891 (BDX—613-2611)
Cayton, T.E., ICRF oscillations of an inhomogeneous plasma cylinder, 6:17767 (LA-UR—81-682)
Cecchi, J., *See* Ulrickson, M., 6:17115
Cederwall, R.T., *See* Shinn, J.H., 6:17345
Celmaster, W., QCD corrections to quarkonia decays, 6:17652 (ANL-HEP-CP—80-60)
Cerling, T., Paleochemistry of Plio-Pleistocene Lake Turkana, Kenya, 6:17546
Cernansky, N.P., Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978, 6:17203 (PB—80-207970)
Cha, B.K., *See* Mueller, R.O., 6:16667
Chalupka, A., *See* Vonach, H., 6:17712
Champion, R.L., *See* Haywood, S.E., 6:17619
Chan, E.W., Effects of polyethylene glycol on reverse transcriptase and other polymerase activities, 6:17476
Chandler, W.S., *See* Atkinson, L.P., 6:17556
See Singer, J.J., 6:17557
Chaney, S., Biochemical effects of inhalation of sulfuric acid mist by human subjects while at rest. Report for 15 January-1 May 1979, 6:17534 (PB—80-210552)
Chang, C.K., *See* Feldberg, S.W., 6:17470
Chang, C.S., *See* Dominguez, R.R., 6:17805
Chang, H.R., Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Chang, I.C., Unsteady transonic flow past airfoils in rigid-body motion, 6:17226 (DOE/ER—03077-170)
Chang, M., *See* Gong, C.S., 6:17465
Chapin, J.A., Idaho National Engineering Laboratory decontamination and decommissioning summary, 6:17417 (CONF-791234—, pp 215-228)
Chaplin, M.R., *See* Zbasnik, J.P., 6:17887
Chapma, R.A., *See* Van Horn, A.J., 6:16797
Chasman, C., *See* Baltz, A.J., 6:17251
Chau Wang, L.L., Way to observe the Higgs boson H^0 in hadronic interactions, 6:17627 (BNL—29072)
Cheddar, G., Environmental effects on electron transfer from chlorophyll triplet to quinone: role of dielectric constant, viscosity and quinone structure in cellulose acetate films, 6:16640 (DOE/ER/04927—T4)
Chelen, E.J., *See* Arthurs, M.J., 6:16363
Chen, J.C., Heat transfer to tubes in freeboard space of fluidized bed combustors. Progress report, August 1, 1980-January 31, 1981, 6:17240 (DOE/PC/30214—T1)
Chen, M., Numerical calculation of the three dimensional electrical field in the central region of a cyclotron, 6:17256 (DOE/ER/40014—1)
See Loeb, D.W., 6:17611
Chen, M.C., *See* Chuang, K.C., 6:16392
Chen, M.M.L., Mechanism of the $H + O_3$ reaction, 6:17155
Cheng, C., *See* Treves, S., 6:17490
Cheng, K.Y., *See* Cho, A.Y., 6:17148
Cheng, Y.S., *See* Dahneke, B., 6:17346
Chevray, R., Chemical reaction and turbulence. Progress report, June 1, 1980-May 31, 1981, 6:17164 (DOE/ER/10439—2)
Chew, H.W., *See* McNulty, P.J., 6:17600
Chiba, Z., *See* Lim, K.J., 6:16801
See Lim, K.L., 6:17244
Childs, R.L., Neutronic calculations for the conceptual design of an in-reactor solid breeder experiment, TRIO-01, 6:17839 (ORNL/TM—7758)
Chimienti, L., *See* Brown, H., 6:17264
Cho, A.Y., Growth of extremely uniform layers by rotating substrate holder with molecular beam epitaxy for applications to electro-optic and microwave devices, 6:17148
Chong, Y.P., *See* Goldenbaum, G.C., 6:17863
Chou, F.K., *See* Yeh, G.T., 6:17431
Chrien, R.E., Observation of d-^{3}He fusion reactions in a tokamak plasma, 6:17688
See McCullagh, C.M., 6:17739
Christensen, J.J., Fourth symposium on macrocyclic compounds, 6:17177 (DOE/ER/10605—4)
Christensen, O.D., Geochemistry of selected rock samples: Colado geothermal area, Nevada, 6:16735 (DOE/ID/12079—24)
Trace-element geochemistry of gradient hole cuttings: Beowawe geothermal area, Nevada, 6:16734 (DOE/ID/12079—21)
Christensen, T.E., Light ion fusion experiment (L.I.F.E.) concept validation studies. Final report, July

1979-May 1980, 6:17830 (DOE/DP/40109—2)
Christianson, C.C., *See* Yao, N.P., 6:17065
Christie, L., *See* Virginia, C., 6:16561
Christophorou, L.G., [Interaction of slow electrons with high-pressure gases (quasi-liquids): synthesis of our knowledge on slow electron-molecule interactions. Progress report for year ending May 31, 1981, 6:17601 (DOE/EV/04703—T1)
Chu, C., Radio frequency current drive in fusioning plasma, 6:17761 (GA-A—16194)
Chu, C.K., *See* Aydemir, A., 6:17866
Chu, J.J., Induced-polarization measurements at Roosevelt Hot Springs Thermal area, Utah, 6:16731 (DOE/ET/28392—23)
Chu, Y., *See* Barish, B., 6:17629, 6:17636
Chuang, K.C., Pyrite desulfurization by wet oxidation in alkaline solutions, 6:16392
Chung, P.M., *See* Im, K.H., 6:17624
Chung, Y.W., Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)
Church, B.W., Nevada Operations overview, 6:17405 (CONF-791234—, pp 61-70)
Church, J.F., *See* Corcoran, W.R., 6:16824
Cierjacks, S., Neutron yields and spectra from 590 MeV (p,n) reactions on lead targets, 6:17725 (DOE/NDC—21/L(Vol.1), pp 201-212)
Ciliberti, D.F., Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978, 6:16798 (PB—80-219249)
Cisneros, C., *See* Mayo, M., 6:17576
Cizewski, J.A., Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
Claar, T.D., *See* Tang, T.E., 6:16951
Clark, A.R., Virtual photoproduction of hidden and open charm, 6:17640 (SLAC—239, pp 539-558)
Clark, J.A., *See* Teufel, L.W., 6:16519
See Warpinski, N.R., 6:16520
Clarke, D.R., Liquid-phase-sintering phenomena of non-oxide silicon compounds. Technical progress report, 1 July 1979-29 February 1980, 6:17139 (DOE/ER/01885—T1)
Clarke, J., *See* Koch, R.H., 6:17217
Clauer, A.H., *See* Wright, I.G., 6:16365
Clauss, D.B., Vertical-axis wind-turbine drive-train transient dynamics, 6:16781 (SAND—80-2646)
Cleary, T.P., *See* Lord, R.S., 6:17272
Clegg, B.R., *See* Robison, W.L., 6:17422
Clements, W.E., *See* Davis, C.G., 6:17353
Clifford, .D.W., Automated fabrication, characterization and transport of ICF pellets. Final report, March 1, 1979-October 31, 1980, 6:16585 (DOE/DP/40083—1)
Clifford, J.E., Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report, 6:16882 (SAND—80-7191)
Clifton, J.M., Variable phase method for the calculation of the scattering phase shift: the bound-state region, 6:17758
Coccetti, G.F., Potential effects of energy related activities on the seasonal trajectories of epiphytic marine diatoms, 6:17463
Cochrane, J.C., *See* Armstrong, W.T., 6:17765
Cockelet, G.R., *See* Carr, R., 6:17504
Coffman, F.E., *See* Staten, H.S., 6:17590
Coggiola, M.J., Angular scattering in electron capture and loss D^- beam formation processes, 6:17572 (BNL—51304, pp 58-64)
Cohen, B.I., Particle-fluid hybrid simulation of field reversal in a mirror plasma, 6:17854 (PPPL—1755, pp 72-75)
Cohen, M.L., *See* Northrup, J.E., 6:17126
Cohn, D.R., *See* Bromberg, L., 6:17822
Cohn, S.H., *See* Ellis, K.J., 6:17526
See Tohyama, C., 6:17525
See Vartsky, D., 6:17322
Cohn, S.M., Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
Cole, M.W., Physical adsorption: rare gas atoms on solid surfaces. Progress report, June 1, 1980-May 31, 1981, 6:17596 (DOE/ER/10454—1)
Probing the helium-graphite interaction, 6:17607
Coles, D.G., *See* Tewhey, J.D., 6:16572
Colestock, P.L., *See* Chrien, R.E., 6:17688
See Strachan, J.D., 6:17819
Colle, R., MQDT analysis of predissociation. I. A two channel problem with semiclassical scattering parameters, 6:17620
Collier, R.K., *See* Schlepp, D.R., 6:16703
Colosimo, D.D., *See* Leibowitz, H.M., 6:17015
Combes, R.S., Thermal energy storage/heat recovery and energy conservation in food processing, 6:16989 (CONF-800483—(Vol.2), pp 436-440)
Comiskey, A.L., *See* Wise, J.L., 6:16769
Concus, P., Shape of a pendent liquid drop, 6:17903
Conrado, C.L., *See* Robison, W.L., 6:17422
Cook, E., *See* Reginato, L.L., 6:17282
Cook, K.L., *See* Serpa, L.F., 6:17548
Coombs, M.A., In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs, 6:17535 (UR—3490-1883)
Cooper, B.R., Chemistry and physics of coal utilization - 1980, 6:16400
Cooper, C.B., *See* Santhanam, C.J., 6:16410
Cooper, J.F., Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
Cooper, R., *See* Bailey, V., 6:17846
Coppi, B., *See* Basu, B., 6:17804
Coquereaux, R., Quark masses and renormalization-scheme dependence in quantum chromodynamics, 6:17666
Corbett, B.L., High flux isotope reactor quarterly report, April, May, and June of 1980, 6:16858 (ORNL/TM—7754)
Corcoran, W.R., Plant designer's view of the operator's role in nuclear plant safety, 6:16824 (CONF-810411—, pp 198-229)
Cordova, F.A., *See* Szkody, P., 6:17564
Cornacchia, M., *See* Puglisi, M., 6:17296
Cornish, D.N., *See* Zbasnik, J.P., 6:17887
Corotis, R.B., Application of statistical techniques to wind characteristics at potential wind energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16772 (DOE/ET/20283—2)
Handbook for the application of statistical techniques to wind characteristics at potential wind-energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16773 (DOE/ET/20283—3)
Corum, K.R., *See* Cohn, S.M., 6:16911
Costanzo, D.A., *See* Caputo, A.J., 6:16552
Cottingham, G., *See* Wanderer, P., 6:17287
Cottingham, J.G., Method of making reflecting film reflector, 6:16723
See Weng, W.T., 6:17265
Coughlin, T.L., *See* Ragland, K.W., 6:17384
Coultes, M.E., Determination of synchronous-machine-stability study constants. Final report, 6:16787 (EPRI-EL—1424(Vol.2))
Coutrakon, G.B., *See* Yamanouchi, T., 6:17643
Cowles, J.R., *See* Scheld, H.W., 6:16659
Cox, A.N., *See* Newman, M.J., 6:17563
Cox, D.J., *See* Simpson, R.E., 6:16423
Crabb, D.G., *See* Terwilliger, K.M., 6:17255
Crabtree, G.W., *See* Johanson, W.R., 6:17112
Craig, A., *See* Powell, J.R., 6:17828
Craighead, E.C., *See* Naidu, J.R., 6:17542
Craighead, H.G., *See* Trotter, D.M. Jr., 6:16711
Cram, D.J., Multiheteromacrocycles that complex metal ions. Fifth progress report, 1 May 1978-30 April 1979, 6:17178 (DOE/ER/70218—T2)
Crandall, D.H., US-Japan Workshop on atomic-collision data for fusion, 6:17773 (ORNL/TM—7675)
Crawford, T.R., *See* Jackson, J.A., 6:16507
Cristy, G.A., Environmental decontamination, 6:17401 (CONF-791234—)
Crocker, L.P., Shift technical advisors: in the eyes of the NRC, 6:16819 (CONF-810411—, pp 89-94)
Croley, T.E. II, *See* Giaquinta, A.R., 6:16789
Cross, A., *See* Mattson, S., 6:16982
Cross, M.T., *See* Corcoran, W.R., 6:16824
Crouthamel, C.E., Nuclear reactor fuel element, 6:16851
Crowell, J.J., Industrial-conservation-technology energy-savings monitoring system, 6:17030 (CONF-800483—(Vol.2), pp 813-819)
Crutzen, P.J., *See* Berg, W.W., 6:17566
Cuddihy, R.G., Potential health and environmental effects of diesel light duty vehicles, 6:17452 (LMF—82)
Cullingford, H.S., Controlling hydrogen behavior in light water reactors, 6:16873 (LA-UR—81-681)
Culwick, B.B., *See* Bozoki, E., 6:17266
Cumali, Z.O., *See* Sullivan, R., 6:16961
Cummings, F.M., Beta and low energy photon response, 6:17310 (PNL—3536, pp 5.1-5.33)

Environmental effects on the Hanford Multipurpose Personnel Dosimeter, 6:17313 (PNL—3536, pp 8.1-8.14)
High energy photon response, 6:17309 (PNL—3536, pp 4.1-4.12)
See Endres, G.W.R., 6:17305, 6:17306, 6:17307
Cunningham, B., EBIC and HVTEM studies of RTR silicon ribbon, 6:16647 (DOE/JPL/954852—7)
Cunningham, J.J., Simple light-level recording device to monitor lighting in animal quarters, 6:17505
Cushing, C.E., Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station, 6:17524 (PNL—3409)
Cushing, C.E. Jr., Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb, 6:17439
Cutchis, P., *See* Dacy, D., 6:17390, 6:17391
Cverna, F.H., Single and double pion production from 800 MeV proton-proton collisions, 6:17644
Czuchlewski, S.J., Threshold conditions for laser-initiated plasma shutters, 6:17762

D

D'arcy-Gomez, G., *See* Peraino, C., 6:17536
Dacy, D., Analysis of options to limit air quality degradation due to misuse of leaded gasoline in cars equipped with catalytic converters. Paper (final), 6:17390 (PB—80-212780)
Papers related to gasoline supply, misfueling and environmental air quality for the summer of 1979. Paper (final), 6:17391 (PB—80-212798)
Dahl, P.F., *See* Hahn, H., 6:17297
Dahlgren, D.A., Light water reactor safety technology program. Quarterly report, October-December 1980, 6:16874 (SAND—81-0473)
Dahneke, B., Similarity theory for aerosol beams, 6:17346 (UR—3490-1979)
Dalcher, A.W., *See* Yang, T.M., 6:16840
Dale, P.J., *See* Chan, E.W., 6:17476
Dalhed, H.E., MHD stability of vertically asymmetric tokamak equilibria, 6:17796 (PPPL—1766)
Damberger, H.H., *See* Krausse, H., 6:16433
Danby, G.T., *See* Allinger, J.E., 6:17263
Dandeno, P.L., *See* Coultes, M.E., 6:16787
Daniels, W.R., Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
Datz, S., *See* Haywood, S.E., 6:17619
Davidson, G.S., Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Davidson, J.N., Academic involvement in shift technical advisor training for the utilities, 6:16820 (CONF-810411—, pp 95-104)
Davies, J.N., *See* Sykes, L.R., 6:17551
Davis, A., Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, August-October 1980, 6:16396 (DOE/PC/30013—3)
Davis, C.F., Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
Davis, C.G., Drainage flow over complex terrain, 6:17353 (LA-UR—80-3052)
Davis, D.D., Roadway powered electric vehicle (RPEV) system concept description and project overview, 6:17073 (UCRL—85425)
Davis, H.G., Liquefaction of Douglas Fir wood slurries: titration of acids and anions in aqueous product and feed slurries, 6:16606 (LBL—12331)
Davis, J.R., *See* Hopkins, R.H., 6:16645
Davis, M.A., Adrenal imaging agents, 6:17196 (DOE/EV/04115—4, pp 36-44)
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4, pp 23-35)
Design and synthesis of new radiopharmaceuticals, 6:17194 (DOE/EV/04115—4, pp 19-22)
Davis, S.L., *See* Strachan, J.D., 6:17819
Davison, A., *See* Jones, A.G., 6:17193
Dawes, M.H., *See* Ahner, D.J., 6:16374
Dawson, G.W., Decontamination of water bodies, 6:17434 (CONF-791234—, pp 195-204)
de Avillez, R., Study of diffusion of oxygen in dilute vanadium alloys using solid electrolytic cells, 6:17085 (DOE/ER/01198—1343)
de Pourbaix, M., *See* Henrikson, S., 6:16573
De Vore, C.R., Current-driven resistive drift instabilities in sheared magnetic fields, 6:17821
De Vuono, A.C., *See* Hajek, B.K., 6:16817
DeAngelis, D.L., *See* Post, W.M., 6:17395
Dehnhard, D., Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
Deju, R.A., Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980, 6:16568 (RHO-BWI—80-100-4Q)
Delahoy, A.E., *See* Vanier, P.E., 6:16637
Delaunay, M., Production of D^- ions by double charge exchange of D^+ on cesium, 6:17586 (BNL—51304, pp 255-262)
See Bacal, M., 6:17588
Demiralp, M., Chemical kinetic functional sensitivity analysis: Elementary sensitivities, 6:17171
Denham, D.H., Criteria development methodology for DOE decommissioning operations, 6:17418 (CONF-791234—, pp 229-235)
Denning, R.S., *See* Bates, F.J., 6:17834, 6:17835
Derenzo, S.E., Imaging properties of a positron tomograph with 280 BGO crystals, 6:17491 (LBL—11858)
Dermawan, H., Nuclear structure approach to the calculation of the imaginary alpha-nucleus optical potential, 6:17701 (DOE/ER/10405—2)
Deroski, B.R., *See* Andrews, L.C., 6:17184
Derouette, J.J., *See* Fassbender, A.G., 6:17037
DeSerio, R., *See* Gay, T.J., 6:17605, 6:17606
DeSilva, A., SPS compact torus experiment, 6:17869 (PPPL—1755, pp 186-188)
Devereux, O.F., Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981, 6:17185 (DOE/ER/02960—T1)
DeVito, B., *See* Allinger, J.E., 6:17263
DeVivo, D.G., Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2), pp 670-673)
DeWerth, D.W., Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)
Improvements in appliance efficiency. Task IV. Corrosive effects of condensate. Annual report for 1979, 6:16972 (PB—80-210735)
DeWitt, P., *See* Chaney, S., 6:17534
Dick, R.J., *See* Rosenberg, H.S., 6:16406, 6:16795
Dickey, H.C., *See* Szedon, J.R., 6:16660
See Temofonte, T.A., 6:16644
Dickinson, T., Rf power systems for the national synchrotron light source, 6:17267 (BNL—29210)
Dietrick, D.L., *See* Sadler, J.W., 6:16942
DiGiacomo, N.J., Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 6:17706
Dimachkieh, S., Choosing power cables on the basis of energy economics, 6:17000 (CONF-800483—(Vol.2), pp 535-542)
DiPippo, R., International developments in geothermal power, 6:16747
Dismukes, G.C., *See* Frank, H.A., 6:17498
Dixit, M.S., *See* Ahmad, S., 6:17736
Dixon, R.L., *See* Yamanouchi, T., 6:17643
Dobecki, T.L., Application of areal seismics to mapping sandstone channels, 6:16511 (SAND—81-0387C)
Dolan, J.F., *See* Hamza, A.V., 6:16564
Dolique, J.M., Limiting secondary plasma effects in cesium cells or jets used in the double charge exchange method for D^- beam production, 6:17573 (BNL—51304, pp 81-89)
Doll, P., Giant resonance studies with high energy heavy ions, 6:17697 (INKA-Conf—79-001-000, pp 119-123)
Doman, D.R., Design guides for radioactive-material-handling facilities and equipment, 6:17206 (HEDL-SA—2191)
Domanus, H.M., *See* Sha, W.T., 6:16724
Dominguez, R.R., Nonlinear theory of high-m tearing modes, 6:17805
Donat, J.R., *See* Sullivan, S.M., 6:16686
Donohue, D.L., Electro-optical detector for spark source mass spectrometry. Pt. 2. Quantitative measurements, 6:17160
Donohue, M., *See* Katz, J.L., 6:16453
Dorn, D.W., Electricity generation by solar central receivers, 6:16682 (UCID—18977)
Dosher, T.M., Scaled physical model studies of the steam drive process. Second annual report, September

1978-September 1979, 6:16486 (DOE/ET/12075—2)
Doss, E.D., Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)
Doss, J.D., *See* Cunningham, J.J., 6:17505
Doucet, H.J., *See* Bacal, M., 6:17575, 6:17588
See Hamilton, G.W., 6:17574
Dougall, D.K., *See* Reuveny, Z., 6:17474
Douglass, P.M., *See* Miller, R.P., 6:16408, 6:16409
Doverspike, L.D., *See* Haywood, S.E., 6:17619
Dreike, P.L., Formation and propagation of a proton ring, 6:17813
Drickamer, H.G., *See* Thomas, M.M., 6:17179
Drooks, L.J., *See* Wooten, J.W., 6:17838
Dubinsky, Z., *See* Falkowski, P.G., 6:17426
Dubow, J., *See* Gale, R.J., 6:16663
Dudnikov, V.G., Some effects of surface-plasma mechanism for production of negative ions, 6:17580 (BNL—51304, pp 137-144)
Duke, C.L., *See* Talbert, W.L. Jr., 6:17715
Dunbar, D., Impact of proposed and alternative 'de minimis' levels for criteria pollutants, 6:17393 (PB—80-221229)
Regulatory impact assessment for the September 5, 1979 proposed regulations for prevention of significant deterioration, 6:17392 (PB—80-220734)
Dunbar, D.R., Program to prevent the significant deterioration of carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead. Interim report, 6:17394 (PB—80-221260)
Duncan, A.A., *See* Osborn, A.G., 6:17336
Duncan, L.M., Ionospheric modification by high-power radio waves, 6:17565 (LA-UR—81-870)
Dunn, J.J., *See* Studier, F.W., 6:17488
Dunn, W., *See* Policastro, A., 6:17351
Dunning, D.E. Jr., *See* Ryan, M.T., 6:17744
Dunning, T.H. Jr., Theoretical characterization of the potential energy curve for hydrogen atom addition to molecular oxygen, 6:17616
Duquette, D.J., *See* Savage, W.F., 6:17087
Durham, W.B., Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature, 6:17554 (UCRL—83789(Rev.1))
Dutton, J.W., Human factors in training, 6:16822 (CONF-810411—, pp 175-182)
Dwyer, P.B., Combination central heat steam and heat pump installation. A comparison of a school with and without heat recovery, 6:16979
Dykhuizen, R.C., *See* Bates, F.J., 6:17834, 6:17835
Dziubakowski, D.J., Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2), pp 674-687)

E

Eagar, T.W., *See* Szekely, J., 6:17088
Eakland, P., Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)
Eakland, P.B., Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Ecker, B., *See* Bailey, V., 6:17846
Eddleman, J.L., *See* Shearer, J.W., 6:17852
Edelstein, A.S., *See* Johanson, W.R., 6:17112
Edelstein, R.B., Solar thermal cost goals, 6:16630 (SERI/TR—633-1063)
Eden, A., Comparison of DOE-2 and TRNSYS solar-heating-system simulation, 6:16705 (SERI/TR—721-822)
Edeskuty, F.J., *See* Cullingford, H.S., 6:16873
Edquist, R.K., Geophysical investigations of the Baltazor Hot Springs known geothermal resource area and the Painted Hills thermal area, Humboldt County, Nevada, 6:16736 (DOE/ID/12079—29)
Edwards, D.F., High-precision multipass reflectometer, 6:17328 (LA-UR—81-679)
Improved aluminum coatings for the ultraviolet, 6:17102 (LA-UR—81-747)
Edwards, L.R., Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)
Edwards, R.J., ISABELLE magnet power supply system performance analysis, 6:17286 (BNL—29188)
Ehret, C.F., *See* Cahill, A.L., 6:17471
See Peraino, C., 6:17536
Ehrhardt, G.J., *See* Kumar, B., 6:17494
Ehst, D.A., Wave-driver options for low-aspect-ratio steady-state tokamak reactors, 6:17826 (ANL/FPP/TM—141)
Ekin, J.W., Materials studies for superconducting machinery coil composites. Interim report, 6:17104 (PB—80-212202)
Ellanna, L.J., Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)
Elliott, D.L., *See* Freeman, D.L., 6:16767
See Paton, D.L., 6:16768
See Wise, J.L., 6:16769
Elliott, J.C., Intense low-emittance-electron-gun development at PHERMEX, 6:17280 (LA-UR—81-783)
Elliott, R.C., *See* Yao, N.P., 6:17065
Ellis, K.J., Critical organ concentration of cadmium in occupationally-exposed workers, 6:17526 (BNL—29066)
See Tohyama, C., 6:17525
See Vartsky, D., 6:17322
Elmaleh, D.R., *See* Brownell, G.L., 6:17198
Elrod, A., Illinois solar greenhouse compendium, 6:16702 (PB—80-222516)
Emanuel, W.R., *See* Van Voris, P., 6:17398
Emerson, C., *See* Cohn, S.M., 6:16911
Emmel, T.E., *See* Kilpatrick, M.P., 6:16413
Ender, R.L., Alaska OCS socioeconomic studies program. Technical report number 31. Bering-Norton petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16496 (PB—80-212624)
Endres, G.W.R., Dosimeter design specifications, 6:17307 (PNL—3536, pp 2.1-2.6)
Hanford Personnel Dosimeter supporting studies FY-1980, 6:17305 (PNL—3536)
Introduction, 6:17306 (PNL—3536, pp 1.1-1.5)
Neutron response study, 6:17308 (PNL—3536, pp 3.1-3.13)
See Aldrich, J.M., 6:17311
See Cummings, F.M., 6:17309
See Kathren, R.L., 6:17314
See Thorson, M.R., 6:17312, 6:17315
Engdahl, R.B., *See* Rosenberg, H.S., 6:16406, 6:16795
Engelmann, R., *See* Willen, E., 6:17288
Enger, M.D., *See* Walters, R.A., 6:17529
Engler, C.R., *See* Scheld, H.W., 6:16659
Ennis, R.M. Jr., *See* Baker, S.P., 6:16865
Epps, J.A., *See* Button, J.W., 6:16529
Estes, C.B., Oklahoma Industrial Energy Management Program, 6:17053 (CONF-800483—(Vol.2), pp 739-746)
Eubank, H.P., *See* Chrien, R.E., 6:17688
See Stewart, L.D., 6:17592
Evans, A.R., *See* Newsom, D.E., 6:17027
Evans, J., Incentives for technological innovation in air pollution reduction: an ETIP policly research series. Volume 3: opportunities for innovation: administration of sections 111(j) and 113(d) (4) of the Clean Air Act and industry's development of innovative control technology. Final report, 6:17387 (PB—80-205024)
Evans, L.S., Considerations of an air-quality standard to protect terrestrial vegetation from acidic precipitation, 6:17527 (BNL—29097)
Evans, R.B., *See* Mage, D.T., 6:17361
Evans, S.H. Jr., Summary of potassium/argon age dating, 1980, 6:16762 (DOE/ID/12079—23)
Everett, L.G., Groundwater quality monitoring of western coal strip mining: preliminary designs for active mine sources of pollution, 6:16414 (PB—80-220502)
Evoniuk, C.J., NO/sub x/ control and recovery from products of combustion, 6:16802
Eyster, J.M., Coal resource information. Volume 2, Part 2. Annotation of selected sources. Final report, 6:16419 (EPRI-EA—673(Vol.2Pt.2))
Coal resource information. Volume 2, Part 3. Bibliography. Final report, 6:16420 (EPRI-EA—673(Vol.2Pt.3))

F

Faehl, R.J., *See* Elliott, J.C., 6:17280
Fairchild, R.G., *See* Packer, S., 6:17512
Faizullah, M., *See* Teynen, P., 6:17167

Falco, C.M., *See* Zheng, J.Q., 6:17111
Falconer, K.L., Site selection criteria for the shallow land burial of low-level radioactive waste, 6:16576 (EGG-WM—5393)
Falk, G., *See* Alston, T.G., 6:16987
Falkowski, P.G., Light-shade adaptation of Stylophora pistillata, a hermatypic coral from the Gulf of Eilat, 6:17426
Farabaugh, E.N., *See* Haller, W., 6:17118
Farmer, B.M., Annual environmental monitoring report: Calendar Year 1980, 6:17441 (MLM—2822)
Farnsworth, A.V. Jr., *See* Sweeney, M.A., 6:16587
Farrar, H. IV, *See* Kneff, D.W., 6:17690, 6:17707
Farrell, K., *See* Powell, J.R., 6:17828
Farrell, M.P., *See* Waterhouse, J.C., 6:17428
Farrow, N.D., White Oak Creek Watershed topographic map and related materials, 6:17544 (ORNL/TM—7289)
Faruqi, A., *See* Frazier, G.C., 6:16383
Fasman, G.D., *See* Schwartz, A.M., 6:17480
Fassbender, A.G., Foreign industry energy effectiveness. Final report for 1979, 6:17037 (PB—80-210743)
Fattal, S.G., *See* Lew, H.S., 6:16790
Faulkner, M.G., *See* McCain, J.D., 6:17062
Fayers, F.J., Evaluation of the potential for EOR using CO_2 in North Sea reservoirs, 6:16477 (CONF-8004140—, pp 203-225)
Feduska, W., High-temperature, solid oxide electrolyte fuel cell power generation system. Quarterly report, June 1, 1980-August 31, 1980, 6:16949 (DOE/ET/17089—T1)
Feezell, R.R., *See* Tsai, C.C., 6:17583
Feibelman, P.J., Interpretation of differential reflectance studies of metal surfaces, 6:17110
Feldberg, S.W., Electron transport across glycerol monooleate bilayer lipid membranes facilitated by magnesium etiochlorin, 6:17470
Feller, K.G., Review of methods for evaluating R and D, 6:16906 (UCID—18890)
Fenimore, E.E., *See* Cannon, T.M., 6:17231
Ferguson, J.R., *See* Shearer, J.W., 6:17852
Ferguson, S.M., *See* Cahill, A.L., 6:17471
Fernandez, J.C., Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)
Ferrell, G.C., *See* Van Horn, A.J., 6:16797
Ferrell, J.K., Solubilities of acid gases and nitrogen in methanol. Final report, September 1979-April 1980, 6:16616 (PB—80-212236)
Feuell, J., Cogeneration at a practical plant level, 6:16998 (CONF-800483—(Vol.2), pp 517-527)
Fidler, E.L., *See* Finch, T.E., 6:16426
Field, R.J., Existence of solitary traveling wave solutions of a model of the Belousov-Zhabotinskii reaction, 6:17175
Figueira, J.F., *See* Czuchlewski, S.J., 6:17762
Fillo, J.A., *See* Powell, J.R., 6:17828
Finch, T.E., Methods and costs of thin-seam mining. Final report, 25 September 1977-24 January 1979, 6:16426 (DOE/ET/12543—1)
Findley, G.L., Fundamental spectroscopic studies of some atmospheric pollutants, 6:17343 (CONF-8005149—1)
Fink, C.F., *See* Potter, R.M., 6:17324
Finlay, R.W., Differential scattering cross section measurements above 20 MeV, 6:17695 (DOE/NDC—21/L(Vol.1), pp 375-388)
See Randers-Pehrson, G., 6:17703
Finley, D.A., *See* Yamanouchi, T., 6:17643
Finn, R., *See* Concus, P., 6:17903
Firestone, R.F., *See* Loeb, D.W., 6:17611
Fisch, N.J., Current generation by minority-species heating, 6:17816
See Kritz, A.H., 6:17806
Fischer, S.R., *See* Spore, J.W., 6:16862
Fisher, A., Compact torus research at UCI, 6:17847 (PPPL—1755, pp 29-32)
Fisher, E.S., Single crystal metal wedges for surface acoustic wave propagation, 6:17232
Fisher, G.L., Serum copper and zinc levels in melanoma patients, 6:17493
Fisher, J.F., *See* Salmon, R., 6:16384
Fisher, P.W., Modeling solid hydrogen storage beds, 6:16601 (ORNL/TM—7561)
Fisk, W.J., Test results and methods: residential air-to-air heat exchangers for maintaining indoor air quality and saving money, 6:16964 (LBL—12280)
Fite, W.L., *See* Halle, J.C., 6:17603
Fitzsimmons, C., *See* Mage, D.T., 6:17361
Fix, J.J., *See* Aldrich, J.M., 6:17311
See Endres, G.W.R., 6:17308
Flack, R.D., *See* Hassenpflug, H.L., 6:17219
Fleischmann, H.H., Results and present status of the relativistic electron ring experiments and their application to Spheromak problems, 6:17850 (PPPL—1755, pp 41-44)
See Smith, A.C. Jr., 6:17877
Flood, W., *See* Lambertson, G., 6:17260
Flotow, H.E., Thermodynamics of the lanthanide trifluorides. IV. The heat capacities of gadolinium trifluoride GdF_3, lutetium trifluoride LuF_3, and yttrium trifluoride YF_3 from 5 to 350°K, 6:17149
Flynn, E.R., *See* Cizewski, J.A., 6:17729
Flynn, L.E., *See* Arens, E.A., 6:16973
Foelsche, H., *See* Weng, W.T., 6:17265
Foerster, C.L., *See* Schneider, W.J., 6:17294
Foerster, T.F.W., Corrosion of metals in coal char environments, 6:16379 (LBL—12152)
Foh, S., Underground hydrogen storage. Final report, 6:16598 (BNL—51275)
Foh, S.E., Thermochemical hydrogen production. Annual report for 1979, 6:16594 (PB—80-210776)
Folz, D.J., Impact of coal cleaning on the cost of new coal-fired power generation. Final report, 6:16447 (EPRI-CS—1622)
Fonash, S.J., *See* Temofonte, T.A., 6:16644
Ford, D., Reporter at large: Three Mile Island. II. The paper trail, 6:16875
Reporter at large: Three Mile Island. I. Class nine accident, 6:16876
Ford, W.E., Direct observation of electron transfer across a lipid bilayer: laser photolysis of an asymmetric vesicle system containing chlorophyll, methyl viologen, and EDTA, 6:17466 (DOE/ER/04927—T1)
Forman, S.E., Reliability of terrestrial photovoltaic modules at various DOE/MIT Lincoln Laboratory Test Sites, 6:16670 (DOE/ET/20279—126)
Forrest, L., Assessment of environmental impacts of light duty vehicle dieselization. Final report, May 1978-March 1979, 6:17061 (PB—80-220759)
Forrester, R.C. III, *See* Salmon, R., 6:16384
Foucher, J.L., D^- ion accelerator immersed in a magnetic field, 6:17593 (BNL—51304, pp 350-354)
See Delaunay, M., 6:17586
Fowler, C.M., Rail gun program, 6:17208 (LA—8669-MS)
Fox, J.N., Influence of core-assembly refueling requirements on LMFBR core-system design, 6:16839 (GEFR-SP—146)
Fraioli, A.V., *See* Pierce, R.D., 6:16946
Fraley, J.E., *See* Simpson, R.E., 6:16423
Frank, H.A., Magnetophotoselection of the triplet state of reaction centers from Rhodopseudomonas sphaeroides R-26, 6:17483
Orientation of the primary donor in bacterial photosynthesis, 6:17498
Frankl, D.R., *See* Cole, M.W., 6:17607
Franz, E., *See* Powell, J.R., 6:17828
Franz, J.A., Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C, 6:17183
Fraser, J.S., Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1), pp 155-167)
Frazier, G.C., Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)
Fread, C.L. Jr., *See* Love, C.M., 6:17339
Freebairn-Smith, R., *See* Bluhm, R., 6:16779
Freeman, D.L., Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)
Freeman, J.R., *See* Baker, L., 6:17759
Frehaut, J., Status of (n,2n) cross section measurements at Bruyeres-le-Chatel, 6:17718 (DOE/NDC—21/L(Vol.1), pp 399-411)
Frey, W., *See* Weng, W.T., 6:17265
Fridriksson, S., *See* Thordarson, O., 6:17501
Friedman, J., Peat gasification: Rockwell International process, 6:16611 (TR—80/031-001, pp 195-222)
Fries, R.J., Cryogenic laser fusion targets by point-contact conduction cooling, 6:16586
Friesner, R., *See* Frank, H.A., 6:17483, 6:17498
Fritzsche, A.E., In situ measurement experiences, 6:17406 (CONF-791234—, pp 71-85)
Fuhrmann, J., *See* Thompson, P., 6:17295
Fujii, E.T., *See* Kamins, R.M., 6:16932

Fullam, H.T., Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for October-December 1980, 6:16591 (PNL—1845-49)
Fullbright, H.J., *See* Elliott, J.C., 6:17280
Furth, H.P., Compact torus concept and the spheromak, 6:17842 (PPPL—1755, pp 3-7)
See Yamada, M., 6:17865

G

Gabriel, T.A., *See* Childs, R.L., 6:17839
Gaffney, E.S., Possible terrestrial volcanic occurrences of gas clathrate hydrates, 6:17550
Gaines, L.L., Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Galayda, J., *See* Batchelor, K., 6:17269
Galayda, J.N., Edge focusing, 6:17252 (BNL—29211)
Inhomogeneities in magnetic field due to variations of lamination gap heights, 6:17253 (BNL—29212)
Gale, R.J., Electrolyte properties for photoelectrochemical cells with emphasis on the molecular adaptation of metallocenes: a review, 6:16663
Gallaher, R.B, Licensee event report sequence coding and search procedure: a training tool, 6:16863 (CONF-810411—, pp 129-141)
Gallaway, B.M., *See* Button, J.W., 6:16529
Gallepp, G.W., *See* Kitchell, J.F., 6:17399
Gallivan, K.A., Detection and integration of oscillatory differential equations with initial stepsize, order and method selection, 6:17895 (DOE/ER/02383—T1)
Gallo, L.E., *See* Hampel, V.E., 6:16878
Gambill, D.T., Preliminary Hot Dry Rock geothermal evaluation of Long Valley Caldera, California, 6:16738 (LA—8710-HDR)
Gamble, R.L., *See* Lutes, I.G., 6:16958
Gammel, G., MEQALAC development at Brookhaven, 6:17271 (BNL—29305)
Gammuto, J.J., Organizing for change: new priorities for training organization in the nuclear industry, 6:16816 (CONF-810411—, pp 46-62)
Ganeriwal, R., US industrial energy consumption and conservation: past and future perspectives, 6:17029 (CONF-800483—(Vol.2), pp 805-812)
Gant, R.E., Energy issues relevant to domed cities, Winooski, Vermont: a case study, 6:17043 (CONF-8003107—2)
Ganther, T., *See* Kennish, W., 6:16959
Gardner, J.F., Critical valve specifications and METC valve-testing projects, 6:16367 (DOE/MC/14522—1, pp 19.1-19.22)
Kamyr P-D Series Full-Borne Ball Valve METC SOA Test Valve No. A-17 state-of-the-art lockhopper valve-testing and development project, 6:16446 (DOE/METC/SP—125)
Test and evaluation of two Sigmon Corporation 6-inch Type K Ball Valves METC SOA Test Valve No. A-4 and METC SOA Test Valve No. B-4 for lockhopper service in coal conversion, 6:16369 (DOE/METC/SP—129)
Gardner, R.H., *See* Carney, J.H., 6:17432
Garin, J., Remotex and servomanipulator needs in nuclear fuel reprocessing plants, 6:16553 (CONF-810337—1)
Garlanger, J.E., Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report, 6:16405 (EPRI-CS—1579(Vol.3)(Add.))
Garling, W.S., Economic analysis of wind-powered refrigeration cooling/water-heating systems in food processing. Final report, 6:16770 (DOE/SEA—1109-20401/81/1)
Economic analysis of wind-powered crop drying. Final report, 6:16776 (DOE/SEA—1109-20401/81/2)
Garner, F.A., Impact of advanced microstructural characterization techniques on modeling and analysis of radiation damage, 6:17100 (HEDL-SA—1936)
Garnir, H.P., *See* Gay, T.J., 6:17605
Garrett, W.R., Scattering by a dipolar system: divergence of cross sections at the critical moment for a point dipole rotor, 6:17604
Garscadden, A., *See* Bailey, W.F., 6:17570
Garver, W.P., Technique for measurement of fast exponentially-decaying signals, 6:17229
Garvey, P.M., *See* Fraser, J.S., 6:17732
Gaskell, D.R., Kinetics of the desulfurization of molten iron. Final report, 6:17083 (DOE/CS/40153—T1)
Gasper, J.R., *See* Habegger, L.J., 6:17451
Gates, O., *See* Warren, S., 6:17532
Gatti, F.L., Computerized control of environmental systems, 6:16957 (CONF-800483—(Vol.2), pp 448-458)
Gaudet, E.F., *See* Hseuh, H.C., 6:17292
Gay, T.J., Energy dependence of alignment in foil collision-excited n = 3 states of He I, 6:17605
Molecular effects in beam-foil collision-induced alignment of He I, 6:17606
Gayheart, T.R., *See* Gardner, J.F., 6:16446
Gear, C.W., Iterative solution of linear equations in ODE codes, 6:17894 (DOE/ER/02383—0078)
Geller, R., *See* Delaunay, M., 6:17586
See Foucher, J.L., 6:17593
Generoso, E.E., *See* Grell, R.F., 6:17475
George, J.F., Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume A. Detailed report, 6:16684 (JHU/APL-SR—80-1A)
George, R.L., *See* Freeman, D.L., 6:16767
See Paton, D.L., 6:16768
See Wise, J.L., 6:16769
Gerber, K.A., *See* Sethian, J.D., 6:17849
Gerber, T.L., *See* Levy, S., 6:16871
Gerberich, W.W., Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II, 6:17095 (DOE/ER/10433—2)
Gerhard, M.A., Diagnostic test systems canister weld joint analysis, 6:17212 (UCID—18750)
Gerwin, R., Method of inferring the magnetic field profiles in the reversed-field pinch, 6:17766 (LA—8738-MS)
Getty, W.D., Field-reversed gun based on the inverse-pinch discharge, 6:17859 (PPPL—1755, pp 143-146)
Geweniger, C., Results from the CDHS neutrino experiment, 6:17638 (SLAC—239, pp 505-519)
Ghirardi, A., *See* Ritschard, R., 6:16889
Ghoshroy, S., *See* Weng, W.T., 6:17265
Giacomelli, E.J., Method for measuring the density of lightweight materials, 6:17321
Giacomini, J.J., Statistical aspects of the cleanup of Enewetak Atoll, 6:17409 (CONF-791234—, pp 100-103)
Giaquinta, A.R., Optimum mechanical draft wet cooling towers to supplement once-through cooling at selected Missouri River sites, 6:16789 (PB—80-212764)
Gibbons, J.W., Thermal ecology: environmental teachings of a nuclear reactor site, 6:17444
Gibbons, P.C., Determinations of lattice and electronic structures of solids by electron scattering. Progress report, 6:17750 (DOE/ER/10440—2)
Gibbs, L., *See* Dunbar, D., 6:17392
Giebink, D.R., *See* Cverna, F.H., 6:17644
Giertz, F., *See* Dacy, D., 6:17391
Giese, R.F., *See* Mueller, R.O., 6:16667
Gilbert, J., Low level heat recovery through heat pumps and vapor recompression, 6:17014 (CONF-800483—(Vol.2), pp 650-656)
Giles, G.E., *See* Wood, R.F., 6:17145, 6:17146
Giles, M.M., *See* Spore, J.W., 6:16862
Gilley, J.R., On-farm US irrigation pumping plants. Final report, 6:16778 (DOE/SEA—7315-20741/81/1)
See Lansford, R.R., 6:16777
Gilliam, L.R., Inventory of power plants in the United States: December 1979, 6:16927 (DOE/EIA—0095(79))
Gillis, D., *See* Hall, N.G., 6:16994
Gilmore, F.R., *See* Carpenter, H.J., 6:16512
Gilmore, R.S., Particle identification by Cerenkov and transition radiation, 6:17319 (SLAC—239, pp 265-285)
Ginley, D.S., *See* Seager, C.H., 6:17153
Ginsberg, D.M., *See* Miller, W.M., 6:17216
Girnius, R.J., *See* Anderson, L.W., 6:17589
Gitlin, S.N., *See* Berg, W.W., 6:17566
Givens, E.N., *See* Ying, D.H.S., 6:16352, 6:16353
Glagola, B.G., *See* Mignerey, A.C., 6:17708
Glass, R.E., Applications of reservoir simulation to in situ coal gasification, 6:16386 (SAND—80-2579)
See Bader, B.E., 6:16387
Glatz, J., Phase and bunch shape measurement in the UNILAC with capacitive probes, 6:17276 (LA-tr—80-42)
Gleason, V.E., Coal and the environment abstract series: mine drainage bibliography 1929-1980. Final report, 6:16416 (PB—80-221062)
Gluckstern, R.L., *See* Krinsky, S., 6:17268
Goebel, R.P., Applications of shallow solar ponds in wastewater treatment, 6:16720 (UCRL—15329)
Goeringer, D.E., Microcomputer-controlled remote pipetter: design and evaluation of a prototype system, 6:17158 (ORNL/TM—7608)
Gohil, R.M., *See* Schultz, J.M., 6:17134

Golabi, K., Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)
Gold, R., Continuous gamma-ray spectrometry in the Fast Flux Test Facility, 6:16841 (HEDL-SA—2116)
Goldberg, B., *See* Hansson, G.V., 6:17330
Goldblatt, M., *See* Moody, D.C., 6:17182
Goldburg, A., Micellar-polymer oil recovery demonstration in the Bell Creek Field, Montana, 6:16479 (CONF-8004140—, pp 243-279)
Golden, J., *See* Pasour, J.A., 6:17851
Goldenbaum, G.C., Dynamically formed spheromak plasma (PS-1), 6:17863 (PPPL—1755, pp 162-165)
Goldstein, D., *See* Levine, M., 6:16905
Goldstein, N.E., *See* Wilt, M., 6:16739
Goldston, R.J., *See* Stewart, L.D., 6:17592
Goldthwaite, W.H., *See* Bates, F.J., 6:17834, 6:17835
Golembiewski, M., Environmental assessment of a waste-to-energy process: Braintree municipal incinerator, 6:17362 (PB—80-219421)
Golembiewski, M.A., Environmental assessment of a waste-to-energy process: Burlington Electric's wood and oil co-fired boiler, 6:16800 (PB—80-220627)
Gollin, G.D., Charm production by muons and its role in scale-noninvariance, 6:17630 (DOE/ER/03072—T3)
Gomberg, H.J., Synthetic fuels from laser fusion, 6:16588
Gong, C.S., Fundamental study of the mechanism and kinetics of cellulose hydrolysis by acids and enzymes. Final report, June 1, 1978-January 31, 1981, 6:17465 (DOE/ER/02755—5)
Goodell, B.D., *See* Ragland, K.W., 6:17384
Goodgame, M.M., *See* Dunning, T.H. Jr., 6:17616
Goodman, P.O., *See* Folz, D.J., 6:16447
Goods, S.H., Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)
See Carling, R.W., 6:16680
Goodstein, D.L., *See* Cole, M.W., 6:17607
Gordon, H.A., Sampling calorimeters in high energy physics, 6:17318 (SLAC—239, pp 241-264)
Gordon, P.R., *See* Bloomer, W.D., 6:17514
Gordon, R.L., Coal industry problems. Final report, 6:16458 (EPRI-EA—1746)
Gorski, S.E., *See* Ender, R.L., 6:16496
Gould, C.R., *See* Walter, R.L., 6:17693
Grabke, H.J., *See* Sakurai, T., 6:17082, 6:17093
Grabmayr, P., *See* Randers-Pehrson, G., 6:17703
Grabowski, H.G., Impact of regulation on industrial innovation, 6:16896
Graham, W.G., Properties of alkali metals adsorbed onto metal surfaces, 6:17579 (BNL—51304, pp 126-133)
See Bacal, M., 6:17575
Grahek, F.E., *See* Berg, W.W., 6:17566
Granneman, E.H.A., Two-wavelength HeNe laser interferometer, 6:17801 (UCID—18988)
See Hopman, H.J., 6:17584
Grant, N.J., *See* Harling, O.K., 6:17832
Grantom, R.L., Combustion air preheat should be more than supply recycling energy, 6:17003 (CONF-800483—(Vol.2), pp 559-564)
Granziera, M.R., Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)
Graves, A.W., Soil surface decontamination and revegetation progress, 6:17413 (CONF-791234—, pp 152-166)
Gray, D., Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
Gray, R.W., *See* Patel, J.G., 6:16344
Greco, I.L., *See* Chan, E.W., 6:17476
Green, T.S., *See* Holmes, A.J.T., 6:17582
Greenbaum, E., Photosynthetic water splitting, 6:16593 (CONF-810345—1)
Greenberg, D., *See* Packer, S., 6:17512
Greenberger, D.M., Reality and significance of the Aharonov-Bohm effect, 6:17756
Greene, A., *See* Thompson, P., 6:17295
Greene, A.F., *See* Willen, E., 6:17288
Greengard, O., *See* Herzfeld, A., 6:17469
Greenhouse, N.A., *See* Naidu, J.R., 6:17542
Greenly, J.B., LONGSHOT injector: a 3/4 kJ, 120 keV pulsed source of 3 x 10^{16} ions for ion ring formation, 6:17848 (PPPL—1755, pp 33-36)
See Dreike, P.L., 6:17813
Greenslade, D.L., *See* Blackburn, L.D., 6:16843
Greenwood, L.R., Review of source characterization for fusion materials irradiations, 6:17274 (DOE/NDC—21/L(Vol.1), pp 75-98)
See Kneff, D.W., 6:17690
Greer, J., *See* Seidl, M., 6:17577
Greer, R.T., *See* Chuang, K.C., 6:16392
Gregg, D.W., Relative merits of alternate linking techniques for underground coal gasification and their system design implications, 6:16377
Gregory, N., *See* Smith, M., 6:16796
Greiner, J.D., *See* Kandil, H.M., 6:17151
Grell, R.F., Synaptonemal complexes at premeiotic interphase in the mouse spermatocyte, 6:17475
Grenon, L., Concentrator-solar-cell development. Final technical report, 27 March 1979-30 March 1980, 6:16656 (SAND—81-7002)
Gresham, J.B., Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications, 6:16633 (SERI/TP—731-1128)
Grest, G.S., Density of states and the velocity autocorrelation function derived from quench studies, 6:17752
Grieser, F., *See* Almgren, M., 6:17191
Griffin, T., Using a wind electric system to generate power into a utility grid: a project in south central rural Minnesota, 6:16775 (DOE/R5/10134—1)
Griffith, J.K., *See* Walters, R.A., 6:17529
Griffith, P., *See* Levin, A.E., 6:16867
Griffith, R.A., *See* Gardner, J.F., 6:16446
Griffith, R.W., *See* Kampas, F.J., 6:17137
See Vanier, P.E., 6:16637
Griffith, W.C., *See* Cuddihy, R.G., 6:17452
Grimes, J.G., *See* Butz, T.R., 6:16535, 6:16536
Grimm, R.C., *See* Dalhed, H.E., 6:17796
Grimmer, D.P., Bonding solar selective absorber foils to glass receiver tubes for use in evacuated tubular collectors: preliminary studies, 6:16712 (LA-UR—81-1023)
Groessing, G., Study of different forms for the recombination function in the formation of mesons from partons, 6:17657 (IS-T—929)
Grogan, P.J., *See* Alston, T.G., 6:16987
Groh, K.R., *See* Peraino, C., 6:17536
Grossmann, W., *See* Hameiri, E., 6:17857
Grove, E., *See* Thompson, P., 6:17295
Grube, K.K., Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)
Gruppelaar, H., Comparison of experimental and calculated neutron emission spectra and angular distributions, 6:17713 (DOE/NDC—21/L(Vol.2), pp 711-729)
Gubernatis, J.E., *See* Albers, R.C., 6:17751
Guenther, P.T., *See* Smith, A., 6:17726
Guernsey, D.L., Thyroid hormone modulation of x-ray-induced in vitro neoplastic transformation, 6:17519
Guidry, M.W., *See* Bingham, C.R., 6:17722
Guinan, M.W., *See* Kneff, D.W., 6:17690
Gulari, E., *See* Magid, L.J., 6:16465
Gunter, E.J., *See* Hassenpflug, H.L., 6:17219
Gurley, W.B., Sequence organization of the soybean genome, 6:17484
Gurwell, W.E., *See* Smith, S.A., 6:16655
Gustavson, H.G., *See* Foucher, J.L., 6:17593

H

Haas, G.M., *See* Staten, H.S., 6:17590
Habegger, L.J., Comparative health and safety assessment of alternative future electrical-generation systems, 6:17451 (CONF-800567—6)
Habercom, G.E. Jr., Oil spill removal techniques and equipment. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980, 6:17437 (PB—80-814809)
Hadley, D.L., *See* Freeman, D.L., 6:16767
Haeusser, O., *See* Ahmad, S., 6:17736
Hafford, P.M., *See* Crandall, D.H., 6:17773
Haft, A.J., Why energy audits aren't enough: an energy management system is required, 6:16992 (CONF-800483—(Vol.2), pp 466-473)
Hagena, O.F., Negative ion production by charge exchange of hydrogen clusters with a cesium vapor target-status report, 6:17587 (BNL—51304, pp 263-269)
Hagenson, R.L., *See* Krakowski, R.A., 6:17878
Hagerman, D.C., LAMPF dual-energy operation, 6:17257 (LA-UR—81-730)
Haggard, D.L., *See* Aldrich, J.M., 6:17311
Hahn, G.T., *See* Kanninen, M.F., 6:16849
Hahn, H., Upgraded coil configuration for ISABELLE magnets, 6:17297 (BNL—29307)
Hajduk, J., *See* Kiefer, J.H., 6:17626
Hajek, B.K., College and university programs for meeting the needs of educating nuclear power plant

personnel, 6:16817 (CONF-810411—, pp 63-82)
Halama, H.J., *See* Briggs, J., 6:17262
See Schneider, W.J., 6:17294
Halbleib, J.A., *See* Miller, P.A., 6:17815
Hall, C.H., *See* Twiss, R., 6:16745
Hall, E.H., *See* Bates, F.J., 6:17834, 6:17835
Hall, N.G., Energy audits on Prince Edward Island, 6:16994 (CONF-800483—(Vol.2), pp 482-487)
Hall, R.C., *See* Gardner, J.F., 6:16446
Halle, J.C., Ionization of uranium atoms by electron impact, 6:17603
Haller, W., Glassy thin films. Final report, 6:17118 (DOE/DP/40095—T1)
Halter, J.M., Techniques for removing contaminated concrete surfaces, 6:17416 (CONF-791234—, pp 185-194)
Halverson, J.E., Static $^3He/^4He$ gas mass spectrometer for low level tritium concentration measurements, 6:17326 (DP-MS—80-105)
Hamblen, D.G., Physical and chemical characterization of coal. Final report, May 1978-January 1980, 6:16398 (PB—80-220775)
Hameiri, E., Singular solutions and the continuous spectrum, 6:17810
Two-dimensional compression in general compact tori, 6:17857 (PPPL—1755, pp 118-121)
Hamilton, G.W., Measurement of H^- and D^- density in plasma by photodetachment, 6:17574 (BNL—51304, pp 90-94)
See Bacal, M., 6:17575
Hamilton, J.H., *See* Peker, L.K., 6:17714
See Plemons, R.E., 6:16399
Hammer, D.A., *See* Dreike, P.L., 6:17813
See Greenly, J.B., 6:17848
Hammer, J.H., Steady state beam driven field-reversed mirror, 6:17855 (PPPL—1755, pp 80-81)
Hammon, H.G., *See* Hoffman, D.M., 6:17133
Hampel, V.E., First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS), 6:16878 (CONF-791258—(Summ.))
Hamza, A.V., Simulation of three-phase fluidized bioreactors for denitrification, 6:16564 (ORNL/MIT—324)
Handley, G.R., Validation of the Monte Carlo criticality program KENO IV and the Hansen-Roach sixteen-energy-group-cross sections for high-assay uranium systems, 6:17214 (Y—2234)
Hanes, M.H., *See* Hopkins, R.H., 6:16645
Hannon S.J., *See* Packer, S., 6:17512
Hansen, F.D., Creep of 50-mm diameter specimens of dome salt from Avery Island, Louisiana, 6:17552 (ONWI—104)
Hanson, D.L., *See* Cizewski, J.A., 6:17729
Hanson, L.K., Axial ligand effects on iron and manganese porphyrins: extended Hueckel calculations of Cyt P450 analogs and of O_2 binding to iron and manganese, 6:17162
Hanson, P.J., Boise geothermal district heating, 1892-1982. Part I. Institutional planning, 6:16759
Hanson, R.N., *See* Davis, M.A., 6:17194, 6:17195, 6:17196
Hansson, G.V., Angle-resolved electron spectrometer with multidetection, 6:17330
Harari, H., From the standard model to composite quarks and leptons. Part I. Standard model, its present status and its open problems. Part II. Composite quarks and leptons, 6:17661 (SLAC—239, pp 141-175)
Harbottle, G., *See* Kaplan, M.F., 6:17156
Hardie, J.E., *See* Mieth, H.C., 6:17032
Harding, C.V., Cellular proliferation and regeneration following tissue damage. Final report, 6:17502 (DOE/EV/02401—T1)
Harding, W.B., Clean room wiping cloths, 6:17205 (BDX—613-2566)
Hargis, P.J. Jr., Trace detection of N_2 by KrF-laser-excited spontaneous Raman spectroscopy, 6:17159
Harling, O.K., Alloy development for irradiation performance in fusion reactors. Annual report, September 1979-September 1980, 6:17832 (DOE/ER/10107—1)
Harner, D.D., Socioeconomic issues associated with the use of peat as an energy resource, 6:17449 (TR—80/031-001, pp 287-297)
Haro, M.T., *See* Ackerman, D.G., 6:17369
Harper, M.R., *See* Garling, W.S., 6:16770, 6:16776
Harrington, W.F., Nuclear security officer training, 6:16825 (CONF-810411—, pp 255-261)
Harris, L.A., Application of coal petrography to the evaluation of magnetically separated dry crushed coals, 6:16444 (CONF-810203—7)
Harrison, G., *See* Ender, R.L., 6:16496
Harrison, T.D., Midtemperature Solar Systems Test Facility predictions for thermal performance based on test data: Custom Engineering trough with glass reflector surface and Sandia-designed receivers, 6:16716 (SAND—80-1964/10)
Harrison, W., Chemistry of bottom sediments from the Cal-Sag channel and the Des Plaines and Illinois Rivers between Joliet and Havana, Illinois, 6:17433 (ANL/ES—112)
Hart, G., *See* Goldenbaum, G.C., 6:17863
Hart, J.R., *See* Carter, W.A., 6:17247
Hart, R.W., DNA repair in a short- and a long-lived rodent species, 6:17521
Hartman, C.W., Formation of toroidal plasma confinement configurations by using hot electrons, 6:17779 (PPPL—1755, pp 68-71)
Stellarmak a hybrid Stellarator: Spheromak, 6:17861 (PPPL—1755, pp 155-158)
See Turner, W.C., 6:17845
Hartman, W.F., *See* McElroy, J.W., 6:16827
Hartwig, E.O., *See* Jones, A.T., 6:17430
Hasegawa, M., *See* Tomita, Y., 6:17775
Haselton, H.H., *See* Tsai, C.C., 6:17583
Hassenpflug, H.L., Experimental study of the critical speed response, of a Jeffcot rotor with acceleration, 6:17219
Hastings, M.R., Hopper popper, 6:16451
Hatton, G.J., Inelastic electron-ion scattering in a dense plasma, 6:17798 (PPPL—1776)
Haught, R., *See* Wilt, M., 6:16739
Hauser, W., Calculations on heat generation in the storage and solidification of MLW/LLW in large-capacity caverns (Reference systems A and B of the in-situ project), 6:16575 (ORNL-tr—4739)
Hawes, R.I., *See* Fayers, F.J., 6:16477
Hawrylak, R., *See* Batchelor, K., 6:17269
Hayes, B., Particle—velocity gauge system for nanosecond sampling rate of shock and detonation waves, 6:17332
Hayes, D.W., *See* Holloway, R.W., 6:17440
Hays, D.D., *See* Pawlewicz, W.T., 6:17890
Hays, I.D., *See* Baalman, R.W., 6:17377, 6:17385, 6:17421, 6:17438, 6:17446, 6:17453, 6:17454, 6:17455, 6:17456, 6:17457, 6:17458, 6:17459, 6:17460, 6:17461, 6:17462, 6:17506, 6:17507, 6:17508, 6:17509, 6:17510
Haywood, F.F., Ground verification of airborne monitor survey, 6:17382 (CONF-791234—, pp 34-40)
See Perdue, P.T., 6:17323
Haywood, S.E., Collisional decomposition of UF_6^-, 6:17619
Hazeltine, R.D., *See* Catto, P.J., 6:17799
Healey, J.T., *See* Mecholsky, J.J., 6:17125
See Wilder, J.A. Jr., 6:17124
Heese, R.N., Status of the National Synchrotron Light Source project, 6:17270 (BNL—29242)
See Galayda, J.N., 6:17253
Hegewisch, S., *See* Wohlfarth, H., 6:17728
Heinemann, H., Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
Heirwegh, T., Energy data handbook (Damocles). Part I: definitions and instructions, 6:16892
Helava, H., *See* Bailey, V., 6:17846
Held, M., Initiation of explosives: a multi-layered problem in detonation physics, 6:17340 (UCRL-Trans—11661)
Helgason, T., Epidemiological investigations concerning affective disorders, 6:17464
Helgerson, R.N., *See* Butz, T.R., 6:16535, 6:16536
Hellbloem, R.P., *See* Foucher, J.L., 6:17593
Heller, J.N., *See* Placet, M., 6:17386
Heller, J.P., Development of mobility control methods to improve oil recovery by CO_2. First annual report, October 1, 1979-September 30, 1980, 6:16488 (DOE/MC/10689—5)
Heller, K., Polarization in inclusive lambda production, 6:17628 (DOE/ER/01764—397)
Hendrick, R.E., Pion-nucleon partial wave analysis and study of baryon structure. Progress report, June 1, 1979-May 31, 1981, 6:17655 (DOE/ER/10402—T1)
Hendricks, R.W., *See* Schultz, J.M., 6:17134
Hendrickson, R.R., Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits, 6:16757 (SAND—80-7136)
Hendrie, D.L., *See* Doll, P., 6:17697
Henins, I., *See* Jarboe, T.R., 6:17777

Henkes, P.R.W., *See* Hagena, O.F., 6:17587
Henningson, J.C., Hudson River cleanup, 6:17427 (CONF-791234—, pp 205-214)
Henrikson, S., Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
Henry, C.D., Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583
Hepburn, A.G., *See* Gurley, W.B., 6:17484
Herbst, E., *See* Haywood, S.E., 6:17619
Herndon, P.G., *See* Baker, S.P., 6:16865
Herrera, J., *See* Willen, E., 6:17288
Hershcovitch, A., *See* Alessi, J., 6:17827
Hertz, J.A., Propagation of sound in a spin-glass, 6:17753
Herzfeld, A., Tissue enzyme changes in parabiotic rats with subcutaneous lymphoma, 6:17469 (DOE/EV/03017—T1)
Herzog, L.F. II, *See* Halverson, J.E., 6:17326
Hester, N., *See* Mage, D.T., 6:17361
Hewett, D.W., Global method of solving the electron-field equations in a zero-inertia-electron-hybrid plasma simulation code, 6:17823
Two-dimensional simulation of compact torus formation, 6:17788 (PPPL—1755, pp 115-117)
Hewson, E.W., Network wind power over the Pacific Northwest. Progress report, October 1978-September 1979, 6:16764 (DOE/BP/01310—T1)
Network wind power over the Pacific Northwest. Appendix I. Wind power site survey report, 6:16765 (DOE/BP/01310—T1(App.I))
Network wind power over the Pacific Northwest. Wind statistics summaries for the wind power data stations, 6:16766 (DOE/BP/01310—T1(App.2))
Heydt, G.T., Research on stochastic power-flow study methods. Final report, 6:16805 (DOE/ET/29102—1)
Hicks, H.R., 3-D nonlinear calculations of resistive tearing modes, 6:17771 (ORNL/TM—7132)
Higginbotham, E.B., *See* Lim, K.J., 6:16801
See Lim, K.L., 6:17244
Hight, R.D., *See* Gay, T.J., 6:17605
Hildebrand, C.E., *See* Walters, R.A., 6:17529
Hildebrand, S.G., *See* Adams, S.M., 6:16855
Hill, R.E., *See* Hagerman, D.C., 6:17257
Hilliard, R.K., *See* McCormack, J.D., 6:16872
Hilscher, D., Neutron emission from the strongly damped reaction $^{165}Ho + ^{56}Fe$ at 8.5 MeV, 6:17719 (INKA-Conf—79-001-000, pp 94-97)
See Mignerey, A.C., 6:17708
Himmel, R.L., Improvements in appliance efficiency. Task II. Improvement of commercial cooking equipment. Annual report for 1979, 6:16971 (PB—80-210727)
Hinerman, K.B., FUSRAP equipment concept development study, 6:17419 (CONF-791234—, pp 236-242)
Hinkle, B., *See* Limaye, D.R., 6:17007
Hinkle, W., Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)
Hinnov, E., *See* Suckewer, S., 6:17797
Hino, Y., Cross sections for the reactions of $^{9}Be(n,t_1\gamma)$ and $^{12}C(n,n'\gamma)$ between 13.0 and 15.0 MeV, 6:17696 (DOE/NDC—21/L(Vol.1), pp 413-420)
Hirose, A., *See* Ishihara, O., 6:17803
Hirsan, I., Effect of bed and jet parameters on vertical jet penetration length in gas fluidized beds, 6:17239 (CONF-801104—13)
Hirsch, E., Guide to financial assistance for wind energy, 6:16771 (P—500-81-014)
Hirshman, S.P., *See* Lao, L.L., 6:17772
Hirst, E., Review of utility home-energy-audit programs, 6:16962 (DOE/TIC—11436)
Hise, E.C., *See* Harris, L.A., 6:16444
Hites, R.A., *See* Kaden, D.A., 6:17537
Hitlin, D.G., Weak decays of strange and heavy quarks, 6:17660 (SLAC—239, pp 67-140)
Hjelmeland, O., Wettability, the key to proper laboratory waterflooding experiments, 6:16467 (CONF-8004140—, pp 1-19)
Hobbs, R.H., *See* Hamblen, D.G., 6:16398
Hock, S.M., Value of thermal storage in solar IPH systems, 6:16706 (SERI/TR—731-905)
Hodges, R.V., *See* Coggiola, M.J., 6:17572
Hoenig, C., Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9), 6:16571 (UCID—18845)
Hoenig, C.L., *See* Tewhey, J.D., 6:16572
Hoffman, A.L., Triggered-reconnection compact toroid experiment, 6:17860 (PPPL—1755, pp 147-150)
See Willenberg, H.J., 6:17879
Hoffman, D.M., Application of structure-property relationships to develop seven segmented polyurethane adhesives, 6:17133 (UCRL—84039)
Hohmann, G.W., *See* Stodt, J.A., 6:16732
Hoida, H.W., *See* Jarboe, T.R., 6:17777
Holje, G., *See* Kunio, D., 6:17496
Holloway, R.W., Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
Hollowell, C.D., *See* Fisk, W.J., 6:16964
See Lepman, S.R., 6:17356
Holman, B.L., *See* Davis, M.A., 6:17194, 6:17195, 6:17196
Holmes, A.J.T., Proposed electrode design for direct extraction of negative ion beams, 6:17582 (BNL—51304, pp 213-216)
Holmes, J.A., *See* Hicks, H.R., 6:17771
Holmes, J.T., Operating experience at the Central Receiver Test Facility (CRTF), 6:16717 (SAND—80-2504C)
Holtz, M., *See* Sax, R.I., 6:16990
Homan, G.R., *See* Rabe, J.A., 6:16722
Homer, M., Fish community studies in the Patuxent estuary, 1978-79. Final report, April 1976-March 1979, 6:17523 (PB—80-209976)
Hommert, P.J., *See* Davidson, G.S., 6:16389
Hooper, E.B. Jr., Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304, pp 247-254)
Hoover, A.D., *See* Hilscher, D., 6:17719
Hoover, J., *See* Dahneke, B., 6:17346
Hopkins, R.H., Silicon materials task of the Low-Cost Solar Array Project: Phase IV. Effects of impurities and processing on silicon solar cells. Twenty-first quarterly report, October-December 1980, 6:16645 (DOE/JPL/954331—81/13)
Hopkinson, R.F., *See* Bullwinkel, H.J., 6:16669
Hopman, H.J., Conceptual D^- source exploiting negative surface ionization of deuterons, 6:17584 (BNL—51304, pp 233-239)
Hopwood, W.H. Jr., *See* Plemons, R.E., 6:16399
Hornbeck, R.G., *See* Gardner, J.F., 6:16446
Horton, W. Jr., Structure in the ion-acoustic spectrum, 6:17807
Hosea, J., Fast-wave ion-cyclotron heating in the Princeton Large Torus, 6:17774 (PPPL—1729)
Hosea, J.C., *See* Chrien, R.E., 6:17688
Hoskins, T.L., *See* Hart, R.W., 6:17521
Hossain, K., *See* Reid, K., 6:16755
Hosterman, J.W., Sample preparation of x-ray diffraction analysis and clay mineralogy of Devonian shale from the Appalachian basin, 6:16524 (DOE/METC—2287/112)
Hough, T., *See* Limaye, D.R., 6:17007
Houghton, R.A., Flax pond ecosystem study: exchanges of CO_2 between a salt marsh and the atmosphere, 6:17400
House, L., *See* Sykes, L.R., 6:17551
Howald, A.M., *See* Anderson, L.W., 6:17589
Howard, P.L., *See* Tarpley, W.B. Jr., 6:16445
Howell, J.A., Computing percentiles of large data sets, 6:17897 (LA-UR—81-1024)
See Johnson, M.E., 6:16548
Howerton, D., Cooperation, commitment add up to worker safety at two mines, 6:16437
More mines make use of satellite imagery as a roof control tool, 6:16441
Howerton, R.J., *See* Smith, A., 6:17726
Hoylman, E.W., *See* Everett, L.G., 6:16414
Hseuh, H.C., Outgassing rate of the copper-plated beam tube for ISABELLE, 6:17292 (BNL—29217)
Hsieh, S.Y., *See* Powell, J.R., 6:17828
Hsu, P.Y., *See* Wessol, D.E., 6:17836
Hsu, W., *See* Beckman, R., 6:16373
Huddle, C.W., *See* Warpinski, N.R., 6:16520
Hudgings, D.W., Los Alamos proton-storage-ring extraction system, 6:17259 (LA-UR—81-784)
See Jason, A.J., 6:17209
Hudson, E.D., *See* Lord, R.S., 6:17272
Hudson, J., *See* Liebenberg, D.H., 6:17142
Huesman, R.H., *See* Derenzo, S.E., 6:17491
Huestis, D.L., *See* Coggiola, M.J., 6:17572
Huff, C.F., Recent developments in polycrystalline diamond-drill-bit design, 6:16754 (SAND—79-1592C)
Huff, D.D., *See* Sledz, J.J., 6:17553
Huffman, F.N., Low work function surface for improving the yield of negative hydrogen ions, 6:17578 (BNL—51304, pp 119-125)

Huizenga, J.R., *See* Hilscher, D., 6:17719
See Mignerey, A.C., 6:17708
Hull, J.R., *See* Sha, W.T., 6:16724
Hull, L.C., *See* Falconer, K.L., 6:16576
Hulseman, R.A., Development of a packed-bed letdown valve for coal-liquefaction plants, 6:16382 (ORNL/MIT—321)
Hundemann, A.S., Energy conservation: policies, programs, and general studies. 1964-1978 (citations from the NTIS data base). Report for 1964-78, 6:16908 (PB—80-813785)
Energy conservation: policies, programs, and general studies. 1979-July 1980 (citations from the ntis data base). Report for 1979-July 1980, 6:16909 (PB—80-813793)
Flat plate solar collector design and performance. 1970-July 1980 (citations from the Engineering Index data base). Report for 1970-July 1980, 6:16714 (PB—80-814122)
Flat plate solar collector design and performance. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980, 6:16715 (PB—80-814130)
Solar energy concentrator design and operation. 1970-July 1980 (citations from the Engineering Index data base). Report for 1970-July 1980, 6:16713 (PB—80-813934)
Hunsaker, C.T., *See* Hunsaker, D.B. Jr., 6:16636
Hunsaker, D.B. Jr., Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)
Hunter, R.B., *See* Romney, E.M., 6:16634
Hunter, W.T., *See* Hagerman, D.C., 6:17257
Hurley, J.K., Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay, 6:17468 (DOE/ER/04927—T3)
Hwang, D., *See* Suckewer, S., 6:17797
Hwang, D.Q., *See* Chrien, R.E., 6:17688
Hyman, D.H., Plasma physics plotting package, 6:17763 (LA—8161-M)
Hyman, H.A., *See* Mandl, A., 6:17222

I

Ichikawa, S., *See* Sawyer, R.H., 6:17011
Ignatiev, A., *See* Smith, G.B., 6:16721
Ikezi, H., Bifurcation of toroidal plasma in a poloidal quadrupole field, 6:17867 (PPPL—1755, pp 180-183)
Ikuta, K., Start-up scenario of compact tori based on REB-injection developed in SPAC-group, 6:17868 (PPPL—1755, pp 184-185)
See Tomita, Y., 6:17775
Im, K.H., Particulate deposition from turbulent parallel streams, 6:17624 (ANL/MHD—81-2)
Ingalls, M.N., Durability demonstration of systems for control of sulfuric acid. Final report, November 1976-September 1979, 6:17360 (PB—80-212129)
Ingersoll, D.T., Final analysis of the GCFR radial blanket and shield integral experiment, 6:16846 (ORNL—5756)
Ingersoll, J., *See* Levine, M., 6:16905
Ingle, R.W., *See* Olsen, D.K., 6:17734
Inglis, W.M., *See* Lone, M.A., 6:17692
Ingra, T.S., *See* Garlanger, J.E., 6:16405
Inman, M., *See* Holmes, A.J.T., 6:17582
Inoue, H., *See* Paciotti, M., 6:17281
Inoue, S., Radio frequency flux control of toroidal plasmas, 6:17795 (PPPL—1755, pp 197-199)
Irby, J.H., *See* Goldenbaum, G.C., 6:17863
Irons, J., *See* Walters, A., 6:16417
Isaacs, H.S., Zirconia fuel cells and electrolyzers, 6:16947 (BNL—29133)
See Kendig, M.W., 6:16832
Isenberg, A.O., *See* Feduska, W., 6:16949
Ishida, T., *See* Adachi, M., 6:17165
Ishihara, O., Nonlinear evolution of Buneman instability, 6:17803
Isser, S., *See* Limaye, D.R., 6:17007
Itagaki, S., *See* Hino, Y., 6:17696
Itikawa, Y., *See* Crandall, D.H., 6:17773
Ito, A.S., *See* Yamanouchi, T., 6:17643
Itoh, K., *See* Inoue, S., 6:17795
Izatt, R.M., *See* Christensen, J.J., 6:17177

J

Jackson, B., *See* Maddalone, R.F., 6:17352
Jackson, C.K., *See* Johnson, M.E., 6:16548
Jackson, J.A., Remote characterization of tight gas sand formations with a new NMR logging tool, 6:16507 (LA-UR—81-735)
See Brown, J.A., 6:16508
Jackson, J.W., *See* Allinger, J.E., 6:17263
Jacob, K.H., *See* Sykes, L.R., 6:17551
Jacquot, C., *See* Bacal, M., 6:17588
See Delaunay, M., 6:17586
See Foucher, J.L., 6:17593
Jadot, P., *See* Heirwegh, T., 6:16892
Jaeger, K., *See* Willen, E., 6:17288
Jahoda, F.C., Lasers as a tool for plasma diagnostics, 6:17768 (LA-UR—81-896)
Jamison, D., *See* Reid, K., 6:16755
Jankowski, R., *See* Kissell, F., 6:16424
Jarboe, T.R., Magnetized gun experiments, 6:17777 (PPPL—1755, pp 53-56)
Jardin, S., *See* Okabayashi, M., 6:17864
Jaros, J.A., Drift and proportional tracking chambers, 6:17316 (SLAC—239, pp 193-213)
Jaroszewicz, T., *See* Alberi, G., 6:17687
Jary, J., *See* Frehaut, J., 6:17718
Jason, A.J., Neutralization of H^- beams by magnetic stripping, 6:17209 (LA-UR—81-831)
See Hudgings, D.W., 6:17259
Jassby, D.L., *See* Stewart, L.D., 6:17592
Jayaraman, N., *See* Kissell, F., 6:16424
Jendrucko, R.J., Field-tested model of industrial energy-conservation assistance to small industries, 6:17024 (CONF-800483—(Vol.2), pp 734-738)
Jepsen, P., *See* Sullivan, S.M., 6:16686
Jernigan, H.C., *See* Cristy, G.A., 6:17401
Jessup, E.S., *See* Cady, W.E., 6:17132
Jody, B.J., *See* Bowman, R.M., 6:17829
Johanson, W.R., Fermi-surface measurements of mixed-valent $CeSn_3$, 6:17112
Johnson, C.E., *See* Crouthamel, C.E., 6:16851
Johnson, D.L., *See* Zanelli, C.I., 6:17702
Johnson, F., *See* Mage, D.T., 6:17361
Johnson, J.H., The application of advanced mine air monitoring techniques to mines using diesel powered equipment. Final report, 1 July 1978-31 July 1979, 6:16429 (PB—80-207541)
Johnson, J.L., *See* Dalhed, H.E., 6:17796
Johnson, K.J., *See* Clark, A.R., 6:17640
Johnson, M.A., *See* Shore, B.W., 6:17602
Johnson, M.E., Geostatistics project of the National Uranium Resource Evaluation program. Progress report, April-September 1980, 6:16548 (GJBX—99(81))
Johnson, M.L., *See* Zanelli, C.I., 6:17702
Johnson, N.R., Laboratory-field experience, 6:17407 (CONF-791234—, pp 86-90)
Johnson, P.M., Multiphoton dissociation spectroscopy and photochemistry. Progress report, July 15, 1980-March 15, 1981, 6:17187 (DOE/ER/10660—1)
Johnson, P.W., Solution of the unitarity equation with overlapping left and right cuts: a tool for study of the S• and similar systems, 6:17680
Johnson, R.G., Source imaging for FMIT using a neutron pin-hole camera, 6:17275 (DOE/NDC—21/L(Vol.2), pp 629-637)
Johnson, S., *See* Storti, G., 6:16662
Johnston, D.C., *See* MacKay, H.B., 6:17128
Johnston, J.E., *See* Zbasnik, J.P., 6:17887
Joiner, J., *See* Beckman, R., 6:16373
Jones, A.G., Studies in technetium chemistry. Progress report, 6:17193 (DOE/EV/04115—4, pp 6-19)
Jones, A.H., *See* Hendrickson, R.R., 6:16757
Jones, A.T., Adenosine triphosphate (ATP) in the marine environment: a bibliography, 6:17430 (LBL—12431)
Jones, D., *See* Berger, E.L., 6:17663
Jones, L.H., High resolution infrared studies of dynamics in low temperature matrics: Vibrational dephasing for SeF_6 in noble gas solids, 6:17610
See Swanson, B.I., 6:17609
Jones, P.W., *See* Homer, M., 6:17523
Jones, R.D., Constants of motion in a helical magnetic field, 6:17811
Josephs, J.M., Feasibility of recycling thorium in a fusion-fission hybrid/PWR symbiotic system, 6:17833 (DOE/ET/51010—9)
Joshi, R., *See* Eakland, P., 6:16503
See Eakland, P.B., 6:16494
Jostlein, H., *See* Yamanouchi, T., 6:17643
Judd, J.L., *See* Wessol, D.E., 6:17836
Judkoff, R., *See* Wortman, D., 6:16978
Jun-sheng, G., *See* Xi-jun, S., 6:17727
Jusko, M.J., *See* Whitfield, R.G., 6:16899

K

Kaden, D.A., Mutagenicity of soot and associated polycyclic aromatic hydrocarbons to Salmonella typhimurium, 6:17537
Kaiser, B.J., *See* Gold, R., 6:16841

Kale, P., Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
Kalt, J.P., Problems of minority fuel-oil dealers, 6:16894 (DOE/PE/70106—T5)
Kamins, R.M., Pricing new energy inputs into electrical supply in Hawaii, 6:16932 (HNEI—80-07)
Kaminsky, M., Clad materials for fusion applications, 6:17889
Kammash, T., *See* Smith, A.C. Jr., 6:17877
See Yakura, S.J., 6:17776
Kampas, F.J., Optical emission studies of reactive species in plasma deposition, 6:17137 (BNL—29161)
Kamptz, H.V., *See* Teynen, P., 6:17167
Kandil, H.M., Single-crystal elastic constants of MgF_2 in the temperature range 4.2—300 K, 6:17151
Kang, K., *See* Rothman, A.C., 6:17670
Kang, S.C., *See* Brasch, F.M. Jr., 6:16811
Kanninen, M.F., Development of a plastic fracture methodology. Final report, 6:16849 (EPRI-NP—1734)
Kapadia, R.R., *See* Henry, C.D., 6:16583
Kapetanakos, C.A., *See* Pasour, J.A., 6:17851
Kaplan, M., Nuclear research with heavy ions. Annual progress report. January 1, 1980-December 31, 1980, 6:17724 (DOE/ER/13246—20)
Kaplan, M.F., Tell el Yahudiyeh Ware: a re-evaluation, 6:17156 (BNL—29258)
Kaplan, S.N., *See* Ahmad, S., 6:17736
Kapner, M., *See* Podder, A., 6:16672, 6:16673
Kapusta, J.I., Effect of exchange-energy corrections on self-consistent meson masses and on the equation of state of nuclear matter, 6:17740
Karney, C.F.F., *See* Kritz, A.H., 6:17806
Karnitz, M.A., Description of district heating: US history and current status, 6:17041 (CONF-810343—1)
Karnowsky, M.M., *See* Carling, R.W., 6:16680
Karpuk, M.E., *See* Hock, S.M., 6:16706
Kasen, M.B., *See* Ekin, J.W., 6:17104
Katerberg, J.A., Comparison of steady-state and second-sound measurements of the Kapitza resistance, 6:17113
Kathren, R.L., Extremity dosimeter studies, 6:17314 (PNL—3536, pp 9.1-9.11)
See Cummings, F.M., 6:17309
See Endres, G.W.R., 6:17305, 6:17306, 6:17307
Katsurai, M., Preliminary studies of spheromak reactors, 6:17874 (PPPL—1755, pp 212-215)
Katz, D., *See* Alston, T.G., 6:16987
Katz, J.L., Condensation processes in coal-combustion products. Progress report, July 1, 1980-June 30, 1981, 6:16453 (DOE/ER/10456—2)
Kaufmann, K.J., *See* Overfield, R.E., 6:17186
Kaugerts, J.E., *See* Hahn, H., 6:17297
Kawin, R.A., *See* Hampel, V.E., 6:16878
Kay, J.F., Compression-molded energy-storage flywheels, 6:16879 (UCRL—15324)
Kazimi, M.S., *See* Granziera, M.R., 6:16869
See Wilson, G.J., 6:16868
Kearns, D.L., *See* Ciliberti, D.F., 6:16798
See Sun, C.C., 6:16799
Keane, J., *See* Gammel, G., 6:17271
Kearney, D.W., Status of current IPH applications, 6:16704 (SERI/TP—632-1123)
Keiser, J.R., *See* Baylor, V.B., 6:16345
Keller, H.J., *See* Glatz, J., 6:17276
Kellner, C.S., Evidence for H_2/D_2 isotope effects on Fischer-Tropsch synthesis over supported ruthenium catalysts, 6:17181
Kellogg, W.W., Climate change and society: consequences of increasing atmospheric carbon dioxide, 6:17448 (DOE/EV/10281—T3)
Kelly, R.L., Energy Responsibility Accounting: an energy-conservation tool for industrial facilities, 6:17021 (CONF-800483—(Vol.2), pp 718-724)
Kelsey, J.R., *See* Varnado, S.G., 6:16758
Kemker, G.H. Jr., *See* Hulseman, R.A., 6:16382
Kendall, J.M., *See* Brink, D.F., 6:16694
Kendig, M.W., Situ corrosion monitoring of steam generators, 6:16832
Kennish, W., Validation of thermal-energy-savings calculations in the SECP handbook. Final report, 6:16959 (DOE/EI/10416—1)
Keon, E., *See* Miller, B., 6:17004
Kernan, A., High energy physics annual report, January 1, 1979-December 31, 1979, 6:17642 (UCR—34P107-263)
Kerr, W., Exploratory energy research program at the University of Michigan. Progress report, 6:16902 (DOE/ER/10125—1)
Kerth, L.T., *See* Clark, A.R., 6:17640
Kesner, J., Tandem-mirror sloshing-electron plugs, 6:17820
Kessel, J., Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650, pp 9.1-9.28)
Chemical Process Research and Development Program, 6:16615 (LBL—11650, pp 4.1-4.39)
Combustion research, 6:17202 (LBL—11650, pp 6.1-6.55)
Energy Analysis Program, 6:16887 (LBL—11650, pp 1.1-1.56)
Energy and Environment Division annual report, 1979, 6:17355 (LBL—11650)
Energy efficient building programs, 6:16963 (LBL—11650, pp 2.1-2.84)
Oil shale research, 6:16525 (LBL—11650, pp 5.1-5.67)
Solar energy program, 6:16627 (LBL—11650, pp 3.1-3.44)
Ketterson, J.B., *See* Zheng, J.Q., 6:17111
Key, J.L., *See* Gurley, W.B., 6:17484
Keys, M.A. IV, *See* Dziubakowski, D.J., 6:17017
Khattak, C.P., *See* Schmid, F., 6:16646
Khatun, S., *See* Qaim, S.M., 6:17704
Khurana, A., *See* Hertz, J.A., 6:17753
Kidwell, C.M., *See* Perry, G.E., 6:16476
Kidybinski, A., Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980, 6:16428 (DOE/TIC—11445)
Kiefer, J.H., Physical optics of the laser-schlieren shock tube technique, 6:17626
Kiely, F.M., *See* Fraser, J.S., 6:17732
Kildal, H., *See* Brueck, S.R.J., 6:17152
Killeen, J., *See* McCoy, M.G., 6:17802
See Shestakov, A.I., 6:17790
Killpack, T.J., *See* Tripp, A.C., 6:17547
Kilpatrick, M.P., Environmental assessment: source test and evaluation report - Willman-Galusha (Ft. Snelling) low-Btu gasification. Final report, September 1978-December 1979, 6:16413 (PB—80-219330)
Kilpinen, U., Operating policies, problems and experiences with the Helsinki energy supply system, 6:17050
Kim, J.E., Theoretical and experimental review of the weak neutral current: a determination of its structure and limits on deviations from the minimal SU(2)/sub L/ x U(1) electroweak theory, 6:17645
King, D.L., *See* Holmes, J.T., 6:16717
King, D.S., *See* Davis, C.G., 6:17353
King, N.S.P., *See* Cverna, F.H., 6:17644
King, R., *See* Tomlinson, J., 6:16430
Kirk, B.L., Inductive modeling of time series: a detrending approach, 6:17893 (CONF-810436—1)
Kirk, H., *See* Willen, E., 6:17288
Kissel, L., *See* Rullhusen, P., 6:17710
Kissell, F., Reducing dust at longwall shearers by confining the dust cloud to the face, 6:16424 (BM-TPR—111)
Kisslinger, J.B., *See* Sykes, L.R., 6:17551
Kistler, C.W., *See* Rosenberg, H.S., 6:16406, 6:16795
Kitchell, J.F., Consumer regulation of nutrient cycling, 6:17399
Kittinger, W.D., Atomics International's recent decommissioning experience, 6:17415 (CONF-791234—, pp 176-184)
Klabunde, J., *See* Strehl, P., 6:17284
Klass, D.L., Energy from biomass and wastes: 1980 update, 6:16664
Klatt, L.N., *See* Goeringer, D.E., 6:17158
Klaus, T.J., Windmill for irrigation pond. Final report, 6:16774 (DOE/R5/10124—T1)
Klein, D.E., *See* Eyster, J.M., 6:16419, 6:16420
Klein, E.R., Selected bibliography of biomedical and environmental applications of stable isotopes V-^{3}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497
Klein, J.W., *See* Robinson, H.J. III, 6:16804
Klein, P.D., *See* Klein, E.R., 6:17497
See Schoeller, D.A., 6:17495
See Tserng, K.Y., 6:17481
Klemm, R.A., *See* Hertz, J.A., 6:17753
Klevans, E.H., Zero dimensional modeling of field-reverse theta pinch machines, 6:17792 (PPPL—1755, pp 135-138)
Klimschmidt, D.E., *See* Santhanam, C.J., 6:16410
Klingelhoefer, R., *See* Hagena, O.F., 6:17587
Knapp, E.A., New applications of particle accelerators in medicine, materials science, and industry, 6:17249 (LA-UR—81-818)
Knapp, F.F. Jr., Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Kneff, D.W., Characterization of the Be(d,n) neutron field by passive dosimetry techniques, 6:17690 (DOE/NDC—21/L(Vol.1), pp 113-132)
Helium generation cross sections for fast neutrons, 6:17707 (DOE/NDC—21/L(Vol.1), pp 289-300)

Knight, C.E. Jr., *See* Cain, W.D., 6:17215
Knight, D.J., *See* Washington, W.M., 6:17347
Knight, G., *See* Naidu, J.R., 6:17542
Knowlton, T.M., *See* Hirsan, I., 6:17239
Koch, C.D., Statistical techniques applied to aerial radiometric surveys (STAARS): principal components analysis user's manual, 6:16534 (GJBX—9(81))
Koch, R.H., Quantum noise theory for the dc SQUID, 6:17217
Koester, R., *See* Hauser, W., 6:16575
Koga, N.N., Water conservation in the home. Final report, 6:16980 (DOE/SF/01910—T2)
Kogut, J., Selection of PAR mines based on several factors, 6:16440
Kogut, J.B., *See* Shigemitsu, J., 6:17675, 6:17676
Kohlstedt, D.L., Inelastic deformation in crystalline non-metallic materials. Progress report, 6:17120 (DOE/ER/04441—4)
Kok, K.D., *See* Bates, F.J., 6:17834, 6:17835
Kolbe, W.F., Microwave spectrometer for the detection of transient gaseous species, 6:17331
Koloc, P., All plasma spheromak: the plasmak, 6:17875 (PPPL—1755, pp 216-219)
Koonce, J.F., *See* Kitchell, J.F., 6:17399
Koopman, R.P., Experimental plan for 40-m^3 liquefied natural gas (LNG) dispersion tests. 1981 tests, 6:16515 (UCID—18585(Suppl.1))
Kootstra, A., *See* MacLeod, M.C., 6:17473
Kopytoff, V., *See* Hampel, V.E., 6:16878
Korich, R.D., Comprehensive energy audit of a large production unit in six weeks, 6:16993 (CONF-800483—(Vol.2), pp 474-481)
Kovacik, J.M., Cogeneration considerations in the 1980's, 6:17006 (CONF-800483—(Vol.2), pp 582-592)
Kozub, R.L., Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
Krakowski, R.A., Preliminary reactor implications of compact tori: how small is compact, 6:17878 (PPPL—1755, pp 228-232)
Kramer, C.M., *See* Carling, R.W., 6:16680
Kramer, R., *See* Powell, J.R., 6:17828
Krapp, C.W., Well data file at the Savannah River Plant, 6:17543 (DP-MS—80-131)
Krause, H.H., *See* Rosenberg, H.S., 6:16406, 6:16795
Krausse, H., Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 1. Summary report. Final report, 1974-76, 6:16432 (PB—80-219454)
Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 2. Detailed report. Final report, 1974-76, 6:16433 (PB—80-219462)
Kretz, R., *See* Wohlfarth, H., 6:17728
Krevet, B., *See* Hagena, O.F., 6:17587
Kreymer, A.E., Search for exotic meson production at 13 GeV/c in the reaction pi-n → p/sub (forward)/X--, 6:17648
Krikorian, A.D., *See* Scheld, H.W., 6:16659
Krinsky, S., Higher-order terms in a perturbation expansion for the impedance of a corrugated wave guide, 6:17268 (BNL—29213)
See Galayda, J.N., 6:17253
Krisch, A.D., *See* Terwilliger, K.M., 6:17255
Kritz, A.H., Effect of resonance broadening on the evolution of the edge of a turbulent spectrum, 6:17806
Kriz, T.A., *See* Gresham, J.B., 6:16633
Krueger, G.P., Composite wood utility poles. Final report, 6:16810 (EPRI-EL—1745)
Kucera, E.T., *See* Harrison, W., 6:17433
Kucera, G.H., *See* Pierce, R.D., 6:16946
Kuenne, R., *See* Dacy, D., 6:17390, 6:17391
Kuhl, D.E., *See* Phelps, M.E., 6:17515
Kuk, Y., Atomic-scale observation of hydrogen-induced crack growth by atom-probe FIM, 6:17092 (DOE/ER/10430—8)
Atom-probe investigation of a micro-crack associated with hydrogen in a Fe-Ti alloy, 6:17080 (CONF-800730—4)
High-performance atom-probe field ion microscope study of segregation and hydrogen cracking in Fe-0.29 Ti, 6:17122 (DOE/ER/10430—7)
See Pickering, H.W., 6:17081
See Sakurai, T., 6:17082, 6:17093
Kukacka, L.E., *See* Zeldin, A.N., 6:16748
Kulkarni, V., *See* Randers-Pehrson, G., 6:17703
Kulkarny, V.A., *See* Shwartz, J., 6:17220
Kulke, B., Design and performance of the 1.5 MV injector for FXR, 6:17283 (UCRL—85060)
Kulmala, H.K., Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
Kumar, B., Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
Kumar, K.D., *See* Adams, S.M., 6:16855
Kundur, P., *See* Coultes, M.E., 6:16787
Kunio, D., Observed detector characteristics in mammography: suggestions for further studies, 6:17496
Kunkel, R.G., High-reliability gas turbine combined-cycle development program: Phase I. Final report, 6:16786 (EPRI-AP—1681(Vol.1))
Kuo, D.M., Comparative analysis of peat gasification reactor configurations, 6:17906 (TR—80/031-001, pp 223-245)
Kupferman, S.L., Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas, 6:17442 (SAND—80-2573)
Kurish, J., *See* Cohn, S.M., 6:16911
Kurnit, N.A., Whispering-mode waveguide, 6:17755 (LA-UR—81-994)
Kurz, M.G., Heatpumps in steam district heating, 6:17048
Kusterer, K.C., Labor productivity in heavy construction: impact on synfuels program employment, 6:17447 (ANL/AA—24)
Kusuda, T., Simplified heating and cooling energy analysis calculations for residential applications, 6:16974 (PB—80-213986)

L

Labaune, G., *See* Bacal, M., 6:17588
LaBella, E.A., *See* Sgambat, J.P., 6:17436
Labno, B.A., *See* Linwick, K.A., 6:17051
Lackey, W.J., *See* Caputo, A.J., 6:16552
Lacks, S.A., Deoxyribonuclease I in mammalian tissues, 6:17472
LaDelfe, P., *See* Edwards, D.F., 6:17102
Laidig, W.D., Large multiconfiguration self-consistent-field wave functions for the ozone molecule, 6:17613
Lamain, H., *See* Bacal, M., 6:17588
Lamb, R.C., Very high energy gamma ray astrophysics. Progress report, August 1, 1980-July 31, 1981, 6:17561 (DOE/ER/10774—1)
Lambert, S.E., Effect of composition and neutron irradiation on the upper critical field of Nb_3Pt, 6:17135
Lambertson, G., Stochastic cooling of 200 MeV protons, 6:17260 (LBL—10757)
Lamontagne, J., Approach to market-penetration analysis for advanced electric-power-generation technologies, 6:16926 (BNL—51285)
Landis, G.P., Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico, 6:16740 (NP—25335)
Landt, J.A., *See* Anderson, D.M., 6:17511
Lane, N.F., *See* Hatton, G.J., 6:17798
Lane, R.O., *See* Randers-Pehrson, G., 6:17703
Lane, S.M., Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region, 6:17717
Langacker, P., *See* Kim, J.E., 6:17645
Langdon, A.B., *See* Ishihara, O., 6:17803
Lange, F.F., *See* Clarke, D.R., 6:17139
Langley, R.A., *See* Whitley, J.B., 6:17831
Lansford, R.R., Economics of wind energy for irrigation pumping, 6:16777 (DOE/SEA—7315-2074/81/2)
Lansing, N.F., 1980 national conference and workshop on coal freezing, 6:16448 (EPRI-WS—80-119)
Lao, L.L., Variational moment solutions to the Grad-Shafranov equation, 6:17772 (ORNL/TM—7616)
Lapointe, A., *See* Podesto, B., 6:16808
Laprade, W.T., *See* Miller, R.P., 6:16408, 6:16409
Larkin, R.J., Environmental assessment data systems user guide: Solid Discharge Data System. Final report, September 1978-September 1979, 6:17904 (PB—80-212483)
See Reider, J.P., 6:17905
Larose, G., *See* Podesto, B., 6:16808
Larsen, J.W., *See* Livesay, B.R., 6:16599
Larson, D.L., *See* Torkelson, L., 6:16679
Larson, D.M., *See* Terry, J.M., 6:16495
Laslett, L.J., *See* Lambertson, G., 6:17260
Laudel, A., Laser machining of ceramic, 6:17235 (BDX—613-2507)
Lawrence, W.P., *See* Mulcahy, T.M., 6:16829
Lawyer, L.L., Post accident training program design at Three Mile Island, 6:16830 (CONF-810411—, pp 1-16)
Layton, F.L., *See* Caputo, A.J., 6:16552
Leacock, R.A., *See* Clifton, J.M., 6:17758
Leaderer, B.P., Seasonal variations in light scattering in the New York region

and their relation to sources, 6:17349 (BNL—29271)
Leavell, W.H., Measurement of transient two-phase flow velocity using statistical signal analysis of impedance probe signals, 6:17225 (CONF-810434—2(Draft))
Leber, R.L., *See* Zbasnik, J.P., 6:17887
Lecky, J.A., Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
Lederman, L.M., *See* Yamanouchi, T., 6:17643
Lee, C.L., *See* Rabe, J.A., 6:16722
Lee, D.K., *See* Hicks, H.R., 6:17771
Lee, H., *See* Kalt, J.P., 6:16894
Lee, J.J., *See* Coccetti, G.F., 6:17463
Lee, T.S., *See* Yao, N.P., 6:17065
Lee, W.B., *See* Forrest, L., 6:17061
Leemann, C., *See* Lambertson, G., 6:17260
Lefferdo, J.M., *See* Brown, C.T., 6:16681
LeGassie, R.W.A., Policy implications of a shift in Federal synthetic-fuel-demonstration responsibility, 6:16921 (DOE/FE—0015)
Legner, H.H., *See* Shwartz, J., 6:17220
Leibowitz, H.M., Evaluation of industrial heat pumps for effective low-temperature heat utilization, 6:17015 (CONF-800483—(Vol.2), pp 657-669)
Leonard, B.R. Jr., Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu, 6:17733 (EPRI-NP—1763)
Leonhardt, W.J., *See* Allinger, J.E., 6:17263
Lepman, S.R., Organic contaminants: a bibliography, 6:17356 (LBL—12199)
Les, J.G., Water quality control at Detroit Edison Central Heating, 6:16792
Leskovar, B., *See* Kolbe, W.F., 6:17331
See Lambertson, G., 6:17260
Lester, P.A., *See* Temofonte, T.A., 6:16644
Lester, T.W., Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Lester, W., *See* Arthurs, M.J., 6:16363
Leung, P., *See* Ruderman, H., 6:16904
Levin, A.E., Development of a model to predict flow oscillations in low-flow sodium boiling, 6:16867 (DOE/ET/37218—2)
Levine, M., Energy efficiency studies: building energy performance standards for residential buildings, 6:16905 (LBL—11972, pp 1.49-1.53)
See Kim, J.E., 6:17645
Levine, M.A., Formation of a compact torus using a toroidal plasma gun, 6:17778 (PPPL—1755, pp 57-60)
See Hartman, C.W., 6:17779
Levit, S., New self-consistent approach to the calculations of nuclear energy levels and their lifetime, 6:17738 (INIS-mf—6088, pp 55-65)
Levy, A.V., *See* Foerster, T.F.W., 6:16379
Levy, P.F., Liquid fuels production from biomass. Final report, 6:16605 (DOE/ET/20050—T4)
Levy, S., Review of proposed improvements, including filter/vent of BWR pressure-suppression and PWR ice containments. Final report, 6:16871 (EPRI-NP—1747)
Lew, H.S., Analysis of construction conditions affecting the structural response of the cooling tower at Willow Island, West Virginia, 6:16790 (PB—80-222631)
Lewis, D.A., Sizes and shapes of short-lived nuclei via laser spectroscopy. Progress report, May 1, 1980-January 31, 1981, 6:17597 (DOE/ER/10496—2)
Lewis, H.R., *See* Cayton, T.E., 6:17767
Lewis, R., Orient mine tragedy, Part II: the conditions were ripe for an explosion, 6:16435
Orient mine tragedy: the last shift before Christmas, 6:16436
Leyerle, R.W., *See* Welsh, L.B., 6:16952
Lichtenberger, D.L., Experimental investigation of the ionizations, electronic strucutre, and bonding of small molecules attached to transition metals. Progress report, 1 September 1980-1 April 1981, 6:17599 (DOE/ER/10746—T1)
Liebenberg, D.H., Absorption spectra of AgI at pressures to 136 kbar, 6:17142 (LA-UR—81-1021)
Lien, C.L., *See* Orr, F.M. Jr., 6:16478
Lilienkamp, R.H., *See* Clifford, .D.W., 6:16585
Lillie, R.A., *See* Childs, R.L., 6:17839
Lim, K.J., Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 1. Technical results. Final report, March 1977-May 1978, 6:16801 (PB—80-220957)
Lim, K.L., Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 2. Appendices. Final report, March 1977-May 1978, 6:17244 (PB—80-212939)
Lim, R., *See* Hoenig, C., 6:16571
Limaye, D.R., Case studies of industrial cogeneration in the US, 6:17007 (CONF-800483—(Vol.2), pp 593-600)
Lin, C.D., Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)
Lin, E.I.H., *See* Sha, W.T., 6:16724
Lin, H.C., *See* Storti, G., 6:16662
See Wang, C.D., 6:17335
Lin, J., *See* Kozub, R.L., 6:17698
Lin, J.S., *See* Schultz, J.M., 6:17134
Lin, W.H., *See* Mulcahy, T.M., 6:16829
Lind, C.D., *See* Koopman, R.P., 6:16515
Lind, D.A., *See* Chen, M., 6:17256
Lindsey, K.E., Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Linford, R.K., LASL Compact Torus Program, 6:17843 (PPPL—1755, pp 12-15)
See Armstrong, W.T., 6:17785
Linkins, A.E., *See* Neal, J.L., 6:17396
Linn, S.H., Molecular beam photoionization study of CO, N_2, and NO dimers and clusters, 6:17612
Study of the ion—molecule half reactions O^+_2(a ^{4}Pi/sub u/, v)xxx(O_2)/sub m/→O^+/sub 2m/+1+O, m=1, 2, or 3, using the molecular beam photoionization method, 6:17170
Linschitz, H., *See* Periasamy, N., 6:17188
Linville, B., Progress review No. 24: contracts for field projects and supporting research on enhanced oil recovery and improved drilling technology. Progress report, quarter ending September 30, 1980, 6:16481 (DOE/BETC—80/4)
Linwick, K.A., Licensing of district heating boilers: the Minnegasco Energy Center, Minneapolis, Minnesota experience, 6:17051
Lioy, P.J., *See* Leaderer, B.P., 6:17349
Lipkin, H.J., Fringing fields and criticisms of the Aharonov-Bohm effect, 6:17757
Why most flavor-dependence predictions for nonleptonic charm decays are wrong: flavor symmetry and final-state interactions in nonleptonic decays of charmed hadrons, 6:17653 (ANL-HEP-CP—80-64)
Lipson, J., *See* Armstrong, W.T., 6:17765, 6:17785
Lister, C.J., *See* Kozub, R.L., 6:17698
Little, N.H., Boise geothermal heating, 1892-1982. Part II. Technical planning, 6:16760
Liu, J.M., Synchrotron topographic project. Progress report, September 1, 1980-February 20, 1981, 6:17298 (DOE/ER/10740—1)
Liu, K.V., *See* Sha, W.T., 6:16724
Livesay, B.R., Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1980-February 28, 1981, 6:16599 (DOE/ER/05246—T1)
Ljungstroem, F., Process for producing shale oil by in-situ electrothermal pyrolysis in a shale deposit, 6:16528 (SAND—81-6001)
Lo, C.C., *See* Lambertson, G., 6:17260
Lo, H.H., *See* Halle, J.C., 6:17603
Loeb, D.W., Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer, 6:17611
Loewenthal, S.H., Advanced continuously variable transmissions for electric and hybrid vehicles, 6:17069 (DOE/NASA/51044—17)
Loferski, P.J., *See* Hosterman, J.W., 6:16524
Logsdon, M., *See* Landis, G.P., 6:16740
Lokken, R.O., Thermal conductivity of multibarrier waste form components, 6:16566 (PNL—3090)
Lone, M.A., Low energy neutron emission from Be(d,n) and Be(p,n) reactions, 6:17691 (DOE/NDC—21/L(Vol.1), pp 147-154)
Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD, 6:17692 (DOE/NDC—21/L(Vol.1), pp 193-199)
Long, J.L., Direct determination of niobium in uranium-niobium alloys, 6:17161
Long, W.F., Assessment of research directions for high-voltage direct-current power systems. Quarterly technical progress report, July 1-September 30, 1980, 6:16806 (DOE/ET/29185—18)
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1980-December 31, 1980, 6:16807 (DOE/ET/29185—19)
Longhurst, G.R., *See* Wessol, D.E., 6:17836
Lord, R.S., Coupled operation of the Oak Ridge isochronous cyclotron and the

25 MV tandem, 6:17272 (CONF-810314—82)

Lorentz, J.J., Feasibility of a geothermal district heating scheme, 6:16761

Lorenz, R.A., Fission-product source terms, 6:17380 (CONF-791234—, pp 9-14)

Loria, R.L., *See* DeWerth, D.W., 6:16970

Los, J., Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304, pp 23-32)

Love, C.M., Thermal analysis investigations of B/$CaCrO_4$, 6:17339 (MLM—2811)

Love, P., *See* Lamontagne, J., 6:16926

Love, S.L., Instrumentation and process control development for in situ coal gasification, 6:16388 (SAND—80-2878)

Lovell, R.T., *See* McCulloch, R.W., 6:16845

Lowery, R.E., Emission laboratory correlation study between EPA and the Japan Automobile Manufacturers Association, Inc. Technical report, 6:17075 (PB—80-209877)

Lu, K.C., *See* Bowman, R.M., 6:17829

Lubon, P., *See* Neufeld, R.D., 6:16402

Luccio, A., Beam - and drive - controlled amplifier for the ISABELLE accelerating system, 6:17289 (BNL—29196)

Lucier, B.J., Effects of curvature on asymmetric steady states in catalyst particles, 6:17163 (ANL—81-7)

Ludemann, C.A., *See* Lord, R.S., 6:17272

Ludwig, P., *See* Bacal, M., 6:17588

See Delaunay, M., 6:17586

Luengo-C, J.R., Estimation of oil recovery by in-situ combustion in the Jobo Field of Eastern Venezuela, 6:16485 (DOE/ET/12056—20)

Luhmann, N.C. Jr., *See* Peebles, W.A., 6:17812

Lui, H.C., *See* Aydemir, A., 6:17866

Lukas, R.L., Effects of local anesthetics on cholinergic agonist binding affinity of central nervous system α-bungarotoxin receptors, 6:17478

Luna, R.E., *See* Wilmot, E.L., 6:16556

Lund, A.E., *See* Krueger, G.P., 6:16810

Lundberg, W.L., Spent fuel dry storage technology development: report of consolidated thermal data, 6:16554 (DOE/NV/00597—6)

Lundy, J.C., Report to the DOE Nuclear Data Committee, 6:17686 (ORNL/TM—7786)

Lunt, R.R., *See* Santhanam, C.J., 6:16410

Lutes, I.G., Operating experience of a coal-fired fluidized bed at Georgetown, University, 6:16958 (CONF-800483—(Vol.2), pp 494-502)

Lutz, S.J., Demonstration of carbon adsorption technology for petroleum dry cleaning plants. Final report, October 1977-April 1979, 6:16502 (PB—80-221039)

Lysne, P., Model for the high-frequency electrical response of reservoir rocks and its application to dielectric-log interpretation, 6:16510 (SAND—81-0371C)

Lytton, M., *See* Gray, D., 6:16347

M

Mabry, R.T. Jr., *See* Yager, J.A., 6:16907

MacCrone, R.K., Protective oxide films. Progress report, 6:17117 (DOE/ER/10428—2)

MacDonald, J.A., *See* Ahmad, S., 6:17736

MacDonald, J.P., *See* Stonehart, P., 6:16950

Macek, R.J., *See* Hagerman, D.C., 6:17257

MacKay, H.B., Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128

Macklin, R.L., Thorium resonance-neutron capture (2.6 to 10 keV), 6:17735 (ORNL/TM—7732)

MacLean, W.C. Jr., See Schoeller, D.A., 6:17495

MacLeod, M.C., Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding, 6:17473

Macler, B.A., Hydrogen formation in nearly stoichiometric amounts from glucose by a Rhodopseudomonas sphaeroides mutant, 6:17479

Maddalone, R.F., Scrubber-generated particulate: literature survey. Final report, 6:17352 (EPRI-CS—1739)

Madsen, V.A., *See* Dermawan, H., 6:17701

Mage, D.T., The RAPS (regional air pollution study) helicopter air pollution measurement program, St. Louis, Missouri, 1974-76. Final report, 6:17361 (PB—80-213119)

Magee, R.A., *See* Kilpatrick, M.P., 6:16413

Magid, L.J., Aggregation of sodium alkylbenzenesulfonates in aqueous solution, 6:16465 (CONF-810308—11)

Magnin, J., *See* Dacy, D., 6:17390, 6:17391

Mahoney, J., *See* Doll, P., 6:17697

Main, R., *See* Lambertson, G., 6:17260

Maish, A.B., Geopressured geothermal drilling and completions technology development needs, 6:16743 (SAND—81-0021)

Maley, M.P., LASL Nb_3Ge conductor development. Sixteenth quarterly progress report, April 1-June 30, 1980, 6:16812 (LA—8606-PR)

Mallon, R.G., *See* Ackerman, F.J., 6:16526

Malterer, T.J., Ground penetrating radar demonstration/evaluation in Minnesota, 6:16421 (TR—80/031-001, pp 313-322)

Mamantov, G., *See* Donohue, D.L., 6:17160

Mandl, A., Mercury—ammonia system at high mercury densities, 6:17222

Mankin, J.B., *See* Carney, J.H., 6:17432

Manne, A.S., ETA-MACRO: a user's guide, 6:16886 (EPRI-EA—1724)

Mansfield, B.K., *See* MacLeod, M.C., 6:17473

Manson, S.T., Energy and angular distributions of electrons from fast $He^+ + He$ collisions, 6:17623

Maple, M.B., *See* Lambert, S.E., 6:17135

See MacKay, H.B., 6:17128

Mar, R.W., *See* Carling, R.W., 6:16680

Maraman, W.J., Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, October 1-December 31, 1980, 6:16844 (LA—8742-PR)

Marchant, D.D., *See* Bates, J., 6:16944

Marianowski, L.G., Status of molten carbonate fuel cell technology, 6:16948 (CONF-810315—8)

See Tang, T.E., 6:16951

Markham, J., *See* Kumar, B., 6:17494

Markuszewski, R., *See* Chuang, K.C., 6:16392

Marle, T.L., *See* Belew, W.W., 6:16628, 6:16687, 6:16707, 6:16726

Marschall, C.W., *See* Kanninen, M.F., 6:16849

Marsh, J., *See* Pasour, J.A., 6:17851

Marshall, F., *See* Radway, J.E., 6:16506

Marshall, J., *See* Jarboe, T.R., 6:17777

Martin, D.L., *See* Lansford, R.R., 6:16777

Martin, J.A., *See* Lord, R.S., 6:17272

Martin, L.W., *See* Binns, D.R., 6:16407

Martin, P., *See* Smith, S.A., 6:16655

Martin, P.M., *See* Pawlewicz, W.T., 6:17890

Martinez, D.R., Parameter estimation in structural dynamics models, 6:17211 (SAND—80-0135)

Marx, J.N., Particle identification by energy loss measurement and long drift imaging chambers, 6:17317 (SLAC—239, pp 215-240)

Maschke, A., *See* Gammel, G., 6:17271

Mase, A., *See* Peebles, W.A., 6:17812

Maslowski, C., *See* Mueller, R.O., 6:16667

Mason, G.R., *See* Ahmad, S., 6:17736

Mass, J., *See* Levine, M., 6:16905

Massmann, P., *See* Hopman, H.J., 6:17584

Massoth, F.E., *See* Ramachandran, R., 6:16491

Masters, L.C., *See* Handley, G.R., 6:17214

Matange, J.N., *See* Ferrell, J.K., 6:16616

Mateja, J.F., *See* Kozub, R.L., 6:17698

Mathews, G.J., *See* Schmitt, R.P., 6:17711

Mathewson, C.C., Evaluation of the impact of Texas lignite development on Texas water resources. Technical completion report, 1 July 1976-30 September 1977, 6:16415 (PB—80-220635)

Mathias, C.J., *See* Kumar, B., 6:17494

Matlock, D.K., *See* Olson, D.L., 6:17086

Matsuda, K., Classical anomalous absorption in strongly magnetized plasmas and effective shielding length, 6:17814

Matthews, L.K., *See* Holmes, J.T., 6:16717

Mattox, D.M., Commercial applications of overlay coating techniques, 6:17077 (SAND—81-0570C)

See Mullendore, A.W., 6:17108

Mattson, L., *See* Neufeld, R.D., 6:16402

Mattson, S., Proposed rear view mirror characteristics and costs. Final report, January-April 1980, 6:16982 (PB—80-208218)

Matwiyoff, N.A., Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)

Maxfield, D.A., Panel discussion on throttle valves, 6:16366 (DOE/MC/14522—1, pp 18.1-18.20)

Proceedings of the 2nd symposium on valves for coal conversion and utilization, 6:16357 (DOE/MC/14522—1)

Mayer, T.A., *See* Washington, W.M., 6:17347

Mayo, M., H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304, pp 106-110)

Mazhari, F., *See* Delaunay, M., 6:17586
Mazur, P.O., Adjustable expandable cryogenic piston and ring, 6:17218
Mazziotta, J.C., *See* Phelps, M.E., 6:17515
McCain, J.D., Assessment of diesel particulate control: particle size measurements. Final report, November 1978-November 1979, 6:17062 (PB—80-224256)
McCall, R.C., Neutron measurements, 6:17745 (SLAC-PUB—2662)
McCandless, F.P., *See* Evoniuk, C.J., 6:16802
McCarthy, R.L., *See* Yamanouchi, T., 6:17643
McCarthy, W.J. Jr., Address at the IDHA conference, 6:17047
McCaslin, J.B., Practical neutron dosimetry at high energies, 6:17743 (LBL—11652)
McClellan, R.O., *See* Cuddihy, R.G., 6:17452
McClendon, L.T., A summary of oil shale activities at the National Bureau of Standards 1975-1979. Final report, 6:16530 (PB—80-223126)
McClure, J.D., Energy technical assistance: industrial processes program, 6:17054 (CONF-800483—(Vol.2), pp 754-759)
See Wilmot, E.L., 6:16556
McCollough, D.H., *See* Wooten, J.W., 6:17838
McCorkle, D.L., *See* Christophorou, L.G., 6:17601
McCormack, J.D., Large-scale tests of aqueous scrubber systems for LMFBR vented containment, 6:16872 (HEDL-SA—2121-FP)
McCormack, M.D., Waste incineration, 6:16559 (CONF-791234—, pp 123-134)
McCoy, M.G., FPPAC: a two-dimensional multispecies nonlinear Fokker-Planck package, 6:17802 (UCRL—85666)
McCoy, M.W., *See* Allen, R.P., 6:16581
McCullagh, C.M., Dipole radiative strength functions from resonance neutron capture, 6:17739
McCulloch, R.W., Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
McElroy, J.W., Experimental study of advanced continuous acoustic emission monitoring of BWR components. Final report, 6:16827 (DOE/ET/34216—T1)
Investigation into continuous acoustic emission monitoring of BWR components. Semi-annual report, 6:16828 (DOE/ET/34216—T2)
McElroy, W.N., *See* Gold, R., 6:16841
McGaffey, R.W., *See* Wooten, J.W., 6:17838
McGee, T.D., Creep of monolithic refractory materials. Final report, 6:16370 (DOE/OR/13405—T1)
McGeoch, M.W., Laser neutralization of negative ion beams for fusion, 6:17591 (BNL—51304, pp 304-311)
McGlaun, J.M., Crater: a computer code for calculating late stage crater formation, 6:17341 (SAND—80-1694)
McGlynn, S.P., *See* Findley, G.L., 6:17343
McGowan, A., Assessment of energy parks vs. dispersed electric power generating facilities. Final report, 15 July 1975-31 December 1976, 6:16936 (PB—80-214273)
McGrogan, S., *See* Hampel, V.E., 6:16878
McGurn, J.S., *See* Rockett, P.D., 6:17764
McHugh, S., Small-scale experiments with an analysis to evaluate the effect of tailored pulse loading on fracture and permeability. Final report for phase I, June 11, 1979-June 11, 1980, 6:16518 (DOE/MC/11577—T9)
McInteer, B.B., *See* Moody, D.C., 6:17182
McLaughlin, W.H., *See* Bloomer, W.D., 6:17514
McLean, R.F., Cost analysis for upgraded passenger car rear signal lighting requirements. Final report, December 1979-June 1980, 6:16983 (PB—80-219728)
McLeod, K.W., Increased cesium uptake by water tupelo under inundated conditions, 6:17443
McMasters, O.D., *See* Johanson, W.R., 6:17112
McNamara, B., *See* Auerbach, S.P., 6:17780
McNaughton, M.W., *See* Cverna, F.H., 6:17644
McNeill, K.L., *See* Fisher, G.L., 6:17493
McNulty, P.J., [Fluorescent scattering by molecules embedded in small particles]. Comprehensive report, 1977-1980, 6:17600 (DOE/EV/04361—T2)
Mead, S.W., *See* Campbell, J.H., 6:16418
Mecholsky, J.J., Applications of scanning electron microscopy to failure analysis in ceramics and glasses, 6:17125 (SAND—81-0063C)
Meehl, G.A., *See* Washington, W.M., 6:17347
Mehrhoff, T.K., Pumping-speed-measurement techniques for getters, 6:17234 (GEPP-OP—563)
Meier, E., *See* Gammel, G., 6:17271
Meier, P., Impact of energy and environmental legislation on industry: problems of regulatory cost assessment, 6:16893 (BNL—28956)
Meier, P.M., Long-range regional power plant siting model. Proc. Paper 14322, 6:16803
Meinert, J.C., *See* Peraino, C., 6:17536
Melia, M., *See* Smith, M., 6:16796
Mellegard, K.D., *See* Hansen, F.D., 6:17552
Menchoca-Rocha, A., *See* Doll, P., 6:17697
Merchant-Geuder, L., *See* Garling, W.S., 6:16770, 6:16776
Mergens, E.H., *See* Brickman, S.W., 6:17025
Merkle, D.H., Full-scale load tests of experimental solar-collector foundations, 6:16718 (SAND—80-7076)
Merklin, J.F., *See* Lester, T.W., 6:17201
Mesko, J.E., Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2), pp 612-621)
Messmer, R.P., Study of local atomic and electronic structure in glassy metallic alloys. Progress report, December 1, 1979-November 1, 1980, 6:17121 (DOE/ER/10382—2)
Metzger, R.M., INDO and MINDO/3 atom-in-molecule polarizabilities, 6:17614
MINDO/3-FP atom-in-molecule polarizabilities of TCNQ, TTF, TMPD, and of their radical ions, 6:17615
Metzler, R.M., Application of selected chemical reactions to the organic chemistry of coal, 6:16397 (IS-T—948)
Meulman, A.P., *See* Ubbels, J., 6:17040
Meuth, H., Periodic field-reversed equilibria for a multiple-cell linear theta pinch, 6:17791 (PPPL—1755, pp 130-134)
Meyer, J.P., *See* Salmon, R., 6:16384
Michael, G.A., Review and future actions, 6:17902 (UCRL—85680(VUGRAPH))
Mieth, H.C., Ninety-two percent minimum heater efficiency by 1980, 6:17032 (CONF-800483—(Vol.2), pp 855-861)
Mignerey, A.C., Charge and mass exchange in ^{56}Fe-induced reactions, 6:17708 (INIS-mf—6088, pp 104-108)
Mignery, A., *See* Hilscher, D., 6:17719
Mihursky, J.A., *See* Homer, M., 6:17523
Mikkelsen, D.R., *See* Stewart, L.D., 6:17592
Miksch, R.R., *See* Lepman, S.R., 6:17356
Milam, D., Determination of laser damage thresholds by comparison with an absolute laser damage standard, 6:17141
Fluence in 1064-nm laser beams: its determination by photography with Polariod film, 6:17223
Milan, N., Even the safest-looking highwall may be as lethal as a rattlesnake, 6:16438
Miley, G.H., Field-reversed configurations: theoretical considerations and reactor applications, 6:17871 (PPPL—1755, pp 200-203)
Millener, D.J., *See* Kozub, R.L., 6:17698
Miller, B., Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers, 6:17004 (CONF-800483—(Vol.2), pp 565-576)
Miller, C.W., Well-bore effects in the analysis of two-phase geothermal well tests, 6:16753 (LBL—12220)
Miller, D.W., *See* Hajek, B.K., 6:16817
Miller, F.L. Jr., *See* Giacomini, J.J., 6:17409
Miller, G., Statistical theory of magnetohydrodynamic turbulence, 6:17809
Miller, J.F., *See* Yao, N.P., 6:17065
Miller, L.G., *See* Wessol, D.E., 6:17836
Miller, P.A., Inverse ion diode experiment, 6:17815
Miller, R.P., Surface mine spoil stability evaluation, interior coal province. Volume I-main report. Glossary of terms (appendix a) and annotated bibliography (appendix b). Contract research (final), September 1977-January 1979, 6:16408 (PB—80-211113)
Surface mine spoil stability evaluation, interior coal province. Volume II-details of mine visits and detailed procedures of laboratory testing (appendix c). Contract research (final), September 1977-January 1979, 6:16409 (PB—80-211121)
Miller, T.R., *See* Kumar, B., 6:17494
Miller, W.M., Device for emptying liquid nitrogen dewars, 6:17216
Miller, W.R., Valve requirements and experience in the H-coal liquefaction

process, 6:16358 (DOE/MC/14522—1, pp 5.1-5.10)
Mills, T.R., *See* Moody, D.C., 6:17182
Millsap, D.A., *See* Wessol, D.E., 6:17836
Milner, W.T., *See* Lord, R.S., 6:17272
Milton, J.C.D., *See* Fraser, J.S., 6:17732
Milton, K., Neutrino mixing in a grand unified theory, 6:17654 (DOE/ER/01545—289)
Mirabella, A.C., Hartford Steam Service Company: annual business report for 1979, 6:17052
Statistical committee report of industry statistics for 1979, 6:17038
Mirin, A.A., *See* McCoy, M.G., 6:17802
Mischke, H., Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912
Mistry, N.B., High energy e^+e^- collider at Cornell using superconducting RF cavities, 6:17301 (SLAC—239, pp 329-341)
Mitchell, A.C., Diagnostic system of the Lawrence Livermore National Laboratory two-stage light-gas gun, 6:17333
Mitchell, D.H., *See* Mudge, L.K., 6:16654
Mitchell, D.S., *See* Jendrucko, R.J., 6:17024
Mizell, S.A., *See* Falconer, K.L., 6:16576
Mlekodaj, R.L., *See* Ritchie, B.G., 6:17730
Mobley, R., *See* Gammel, G., 6:17271
Moehlecke, S., *See* Lambert, S.E., 6:17135
Mohr, C.M., *See* Spore, J.W., 6:16862
Mohri, A., Injection of relativistic electron beam into toroidal systems, 6:17844 (PPPL—1755, pp 8-11)
See Tomita, Y., 6:17775
Moir, D.C., *See* Elliott, J.C., 6:17280
Mollenkopf, H.C., *See* Hopkins, R.H., 6:16645
Molloy, R.C., Oxygen and opacity stack-emission monitoring systems to optimize combustion efficiency and meet EPA requirements, 6:17005 (CONF-800483—(Vol.2), pp 577-581)
Molyneaux, M.S., *See* Levy, P.F., 6:16605
Moneti, G., Results from CESR, 6:17303 (SLAC—239, pp 361-380)
Mongon, A., Energy conservation in French industry and at Rhone-Poulenc, 6:17019 (CONF-800483—(Vol.2), pp 700-711)
Montemurro, P.A., *See* Nawrocky, R.J., 6:17293
Montgomery, H.E., Results fron CERN muon scattering experiments, 6:17639 (SLAC—239, pp 521-538)
Moody, D.C., Alumina-catalyzed isotope exchange in CO/sup 1 2/, 6:17182
Mook, H.A., Temperature dependence of the spin dynamics of EuO, 6:17127
Moore, D., Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico, 6:16708 (SOLAR/1008—80/50)
Moore, D.E., *See* Kupferman, S.L., 6:17442
Moore, F.S., *See* Gold, R., 6:16841
Moore, R.C., Effects of subsidence from thick seam coal mining on hydrology. Open file report (final), July 1979-March 1980, 6:16412 (PB—80-219280)
Moretto, L.G., *See* Schmitt, R.P., 6:17711
Morgan, M., *See* Eden, A., 6:16705
Morgan, T.J., Collision cross sections and equilibrium fractions of ions and atoms in metal vapor targets. Project progress report, June 1, 1979-May 31, 1980, 6:17760 (DOE/ET/53048—3)
See Mayo, M., 6:17576
Morgan, W.D., *See* Ellis, K.J., 6:17526
Morikawa, G.K., Compact toroidal plasma equilibrium and implications on stability, 6:17794 (PPPL—1755, pp 193-196)
Morimoto, K., Cell cycle kinetics in human lymphocyte cultures, 6:17518
Mork, K., *See* Rullhusen, P., 6:17710
Morley, L., *See* Tomlinson, J., 6:16430
Morrow, N.R., Measurement and correlation of conditions for entrapment and mobilization of residual oil, 6:16470 (CONF-8004140—, pp 41-70)
Morrow, P.E., Evaluation of the physical properties of monodisperse and heterodisperse aerosols used in the assessment of bronchial function, 6:17503 (UR—3490-1977)
Morse, T., *See* Podder, A., 6:16673
Moseley, C.L., Health hazard evaluation determination report: HE 79-124-682: Orlando International Airport, Orlando, Florida, 6:17373 (PB—80-223514)
Moser, H.L., *See* Hagena, O.F., 6:17587
Mosher, A., Proceedings of Summer Institute on Particle Physics: the weak interaction, 6:17632 (SLAC—239)
Mosko, S.W., *See* Lord, R.S., 6:17272
Moteff, J.D., *See* Zielinski, R.E., 6:16509
Moulder, G.R., *See* Tarpley, W.B. Jr., 6:16445
Mount, M.E., *See* Robison, W.L., 6:17422
Mountfort, M.V., *See* Lorentz, J.J., 6:16761
Mudge, L.K., Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
Mueckenheim, W., *See* Rullhusen, P., 6:17710
Mueller, R.O., Residential solar-photovoltaic power systems: the need for battery storage, 6:16667 (CONF-800567—5)
Mulcahy, T.M., Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers, 6:16829 (GEAP—24310)
Mullendore, A.W., Thermal-fatigue testing of coatings for fusion-reactor applications, 6:17108 (SAND—80-2431C)
See Pierson, H.O., 6:17144
See Whitley, J.B., 6:17831
Mullens, J.A., *See* Leavell, W.H., 6:17225
Muller, K., *See* Chaney, S., 6:17534
Mulligan, S.W., *See* Lutz, S.J., 6:16502
Mulvey, J.H., Review of experiments on charmed particle lifetimes, 6:17641 (SLAC—239, pp 573-599)
Mumma, S.A., Hardware package and workshop development for homeowner solar water heater, 6:16700 (DOE/SF/01973—T1)
Munford, J.W., *See* Carling, R.W., 6:16680
Munson, J.S., Issues in the use of wood as an energy source in the northeastern US, 6:16638 (BNL—51196)
Murdy, W.H., *See* Ragsdale, H.L., 6:17531
Murphy, R., *See* Reid, K., 6:16755
Murr, L.E., *See* Torma, A.E., 6:16381
Mustard, D.G., Determination of metal crystallite size and morphology in supported nickel catalysts, 6:17172
Muth, A., Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397
Mutschlecner, J.P., *See* Davis, C.G., 6:17353
Myers, N.S., Conservation theory process control using variable frequency drives, 6:17001 (CONF-800483—(Vol.2), pp 543-545)

N

Nachman, M., *See* Hamilton, G.W., 6:17574
Nagahama, K., Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—, pp 145-165)
Nagel, S.R., *See* Grest, G.S., 6:17752
Nagle, D.E., Prospects for pion and kaon factories, 6:17278 (LA-UR—81-746)
Naidu, J.R., Marshall Islands: a study of diet and living patterns, 6:17542 (BNL—51313)
Nairn, J.A., *See* Frank, H.A., 6:17498
Nakaishi, C.V., Ceramic corrosion/erosion project description, 6:16368 (DOE/METC/SP—111)
Nakata, M.M., *See* Kneff, D.W., 6:17707
Nall, D.N., *See* Arens, E.A., 6:16973
Nanis, L., Workshop on electrodes for flowing solution batteries. Summary report, 6:16881 (EPRI-WS—79-192)
Narihara, K., *See* Mohri, A., 6:17844
See Tomita, Y., 6:17775
Nawrocki, M.A., *See* Moore, R.C., 6:16412
Nawrocky, R.J., Design of fast kickers for the ISABELLE beam abort system, 6:17293 (BNL—29218)
Neal, J.L., Influence of temperature on nonenzymatic hydrolysis of p-nitrophenyl phosphate in soil, 6:17396
Needham, G.A., *See* Zanelli, C.I., 6:17702
Neef, W.S. Jr., *See* Carlson, G.A., 6:17885
Negele, J.W., *See* Levit, S., 6:17738
Negus-de Wys, J., Geochemistry studies in Eastern Kentucky. Final report, 6:16464 (DOE/ET/12138—T3)
Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report, 6:16463 (DOE/ET/12138—T2)
Neimark, L.A., Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Neirinckx, R.D., *See* Bloomer, W.D., 6:17514
Nellis, W.J., *See* Mitchell, A.C., 6:17333
Nelson, D.J., Automatic load forecasting. Final report, 6:16910 (EPRI-EL—1758)
Nelson, S.H., Energy savings attributable to switching from master metering to individual metering of electricity, 6:16956 (ANL/EES-TM—124)
Nelson, W.J., *See* Krausse, H., 6:16433
Neufeld, R.D., Bio-oxidation of thiocyanates typical of coal

conversion effluents. Final report, 6:16402 (DOE/ET/04502—7)
Neumann, H.J., Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs, 6:16472 (CONF-8004140—, pp 105-115)
Neuworth, M., *See* Gray, D., 6:16347
Newcomb, W.A., *See* Anderson, D.V., 6:17781
Newkirk, H.W., *See* Tewhey, J.D., 6:16572
Newlon, C.E., Device for absorbing mechanical shock, 6:17207
Newman, J.R., Effects of air emissions on wildlife resources. Air pollution and acid rain report No. 1, 6:17371 (PB—80-221708)
Newman, J.S., *See* Foerster, T.F.W., 6:16379
Newman, M.J., Collisions of asteroids on neutron stars as a cause of cosmic gamma ray bursts, 6:17563
Newsom, D.E., Approach to evaluating equipment-efficiency policies, 6:17027 (CONF-800483—(Vol.2), pp 791-795)
Newton, G.J., Low-Btu-gasifier emissions toxicology. Status report, June 1980, 6:17533 (LMF—77)
Ng, C.Y., *See* Linn, S.H., 6:17170, 6:17612
Nicholas, D.D., *See* Krueger, G.P., 6:16810
Nichols, B.E., *See* Strong, S.J., 6:16671
Nichols, C.L., *See* Robinson, J.N., 6:16967
Nichols, L.L., *See* Endres, G.W.R., 6:17308
Niebergall, F., Some results from the charm neutrino experiment at the CERN SPS, 6:17637 (SLAC—239, pp 487-503)
Nieves, L.A., Regional variations in US residential-sector fuel prices: implications for development of building energy-performance standards, 6:16976 (PNL—3605)
Nissen, D.A., *See* Carling, R.W., 6:16680
Nogi, Y., Spheromak formation by theta pinch, 6:17858 (PPPL—1755, pp 139-142)
Norem, N.J., *See* Carling, R.W., 6:16680
Northrup, J.E., Electronic structure of the rotation twin stacking fault in β-ZnS, 6:17126
Novak, K.M., *See* Robinson, C.V., 6:16854
Novil, M., *See* Foh, S., 6:16598
Novosad, J., Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—, pp 71-95)
Nowacki, L.J., *See* Rosenberg, H.S., 6:16406, 6:16795
Nozaki, S., *See* Sullivan, R., 6:16961
Nunn, A.B., *See* Lutz, S.J., 6:16502
Nutter, C., Interactive modeling system for 2-D magneto-telluric and line source resistivity data (MT2D users guide and documentation), 6:16729 (DOE/ET/27002—1)
Nutter, T.M., *See* Gardner, J.F., 6:16446

O

O'Connell, L.G., Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
See Hampel, V.E., 6:16878
O'Connor, T.E., *See* Chan, E.W., 6:17476
O'Doherty, B., *See* Wortman, D., 6:16978
O'Hare, P.A.G., *See* Flotow, H.E., 6:17149
O'Neil, J.P., Practical procedures for auditing industrial boiler plants, 6:17002 (CONF-800483—(Vol.2), pp 546-558)
O'Neill, R.V., *See* Carney, J.H., 6:17432
See Kitchell, J.F., 6:17399
See Van Voris, P., 6:17398
O'Sullivan, J.B., *See* Marianowski, L.G., 6:16948
O'Sullivan, M.J., *See* Miller, C.W., 6:16753
O'Toole, S.L., *See* Ackerman, C.D., 6:16361
Oakberg, E.F., *See* Grell, R.F., 6:17475
Oblow, E.M., Mathematical foundations of LEAP, 6:16890 (ORNL—5754)
Ochoa, E., *See* Edwards, D.F., 6:17102
Ocken, H., *See* Neimark, L.A., 6:16826
Odette, G.R., *See* Garner, F.A., 6:17100
Oettinger, P.E., *See* Huffman, F.N., 6:17578
Ogden, J., *See* Koloc, P., 6:17875
Ogura, H., *See* Nogi, Y., 6:17858
Ohkawa, T., Control of impurities in toroidal plasma devices, 6:17888
Physics of the OHTE, 6:17853 (PPPL—1755, pp 65-67)
Stabilization of toroidal plasma devices, 6:17825
Ohlsson, E.T., *See* Alison, D.R., 6:16431
Okabayashi, M., Spheromak equilibrium and stability and numerical studies of a spheromak formation scheme, 6:17864 (PPPL—1755, pp 166-170)
See Yamada, M., 6:17865
Okuda, H., *See* Okabayashi, M., 6:17864
Olien, N.A., Superconducting devices and materials. A literature survey issued quarterly, July-September 1980. Issue No. 80-03, 6:17210
Oliensis, J., How to calculate the heavy-quark fragmentation function: an application of cut vertices, 6:17667
Oliker, I., Piping networks for district heating applications, 6:17049
Olin, A., *See* Ahmad, S., 6:17736
Oliphant, T.A., Dynamic and quasi-equilibrium Lagrangian MHD in 1-D, 6:17824
Oliver, B.M., *See* Kneff, D.W., 6:17707
Oliver, R., *See* Dacy, D., 6:17390
Olness, J.W., *See* Poletti, A.R., 6:17705
Olsen, D.K., Measurement of neutron-transmission spectra through ^{232}Th from 8 MeV to 4 keV, 6:17734 (ORNL/TM—7661)
Olson, D.L., Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)
Olson, R.E., Theoretical investigations of the collision dynamics in H^- formation and destruction, 6:17571 (BNL—51304, pp 51-57)
Ong, A., *See* Guernsey, D.L., 6:17519
Onishi, Y., *See* Cushing, C.E., 6:17524
Ono, Y., *See* Linn, S.H., 6:17170, 6:17612
Onstott, E.I., Electrochemically controlled charging circuit for storage batteries, 6:16883
Ophaug, R.A., Economics of steam/electric generation, 6:17008 (CONF-800483—(Vol.2), pp 601-611)
Oras, J.J. Jr., *See* Sha, W.T., 6:16724
Orbesen, S.D., *See* Cizewski, J.A., 6:17729
Oriani, R.A., Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)
Orr, F.M. Jr., Displacement of oil by carbon dioxide, 6:16489 (NP—25370)
Phase behavior of CO_2 and crude oil in low temperature reservoirs, 6:16478 (CONF-8004140—, pp 227-242)
Orthel, J.L., *See* Christensen, T.E., 6:17830
Ortman, D., *See* Reid, K., 6:16755
Ortolani, S., Some properties of the heating and confinement in the RFP configuration, 6:17782 (PPPL—1755, pp 89-93)
Osani, Y., *See* Nogi, Y., 6:17858
Osborn, A.G., Study of PETN/LX-13 from semi-continuous recrystallized Mil. Spec. PETN, 6:17336 (MHSMP—81-08)
Osowitt, M., *See* Kessel, J., 6:16525, 6:16615, 6:16627, 6:16887, 6:16963, 6:17202, 6:17329, 6:17355
Osterfeld, F., *See* Dermawan, H., 6:17701
Otto, R., *See* Hoenig, C., 6:16571
Overbosch, E.A., *See* Los, J., 6:17569
Overcash, M.R., *See* Pal, D., 6:16501
Overfield, R.E., Electron transfer in systems of well-defined geometry, 6:17186 (DOE/ER/10392—4)
Owen, W.H., Induction machine, 6:16783
Owens, J., *See* Hoenig, C., 6:16571
Owens, T., Estimates of occupational safety and health impacts resulting from large-scale production of major photovoltaic technologies, 6:16631 (BNL—51324)
Oxley, J.H., *See* Rosenberg, H.S., 6:16406, 6:16795

P

Paciotti, M., Beam characteristics in the LAMPF biomedical channel, 6:17281 (LA-UR—81-805)
Packer, S., Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Page, G.C., *See* Kilpatrick, M.P., 6:16413
Pal, D., Assessment of land treatment technology for petroleum refinery solid wastes, 6:16501 (PB—80-220593)
Pallaver, C.B., *See* Mazur, P.O., 6:17218
Palmer, F.A., Revision to ANSI/ANS 3.1 1978: resulting from TMI-2, 6:16847 (CONF-810411—, pp 17-31)
Paltiel, Z., *See* Levit, S., 6:17738
Pangborn, J.B., *See* Foh, S.E., 6:16594
Pargellis, A.N., *See* Seidl, M., 6:17577
Park, H., *See* Peebles, W.A., 6:17812
Park, J.E., Calculation of the isotope distribution in a gas centrifuge, 6:16549 (K/CSD/TM—36)
Parrott, J.R. Sr., Cleanup of building 3019 and surroundings at ORNL following plutonium release of November 20, 1959, 6:17411 (CONF-791234—, pp 135-143)
Parry, G., Role of SRC gene in growth regulation of Rous sarcoma virus-

infected chicken embryo fibroblasts, 6:17486
Pasierb, E., *See* Sobel, H.W., 6:17634
Pasour, J.A., Reversed field configurations generated by proton pulses, 6:17851 (PPPL—1755, pp 45-48)
Pate, B.D., *See* Fraser, J.S., 6:17732
Patel, A.S., *See* Ahner, D.J., 6:16374
Patel, G. L., Immunoreactive helix-destabilizing protein localized in transcriptionally active regions of Drosophila polytene chromosomes, 6:17487
Patel, J.G., Memphis demonstration plant program, 6:16344 (CONF-800878—2)
Paterson, J.M., PEP, 6:17302 (SLAC—239, pp 343-347)
Paton, D.L., Wind energy resource atlas. Volume 3. Great Lakes Region, 6:16768 (PNL—3195-WERA-3)
Patterson, D., *See* Johnson, M.E., 6:16548
Patterson, D.R., Results of an accuracy test of the Mod-II Site Data Acquisition System, 6:16688 (ANL/EES-TM—128)
Paul, R.A., *See* Dunbar, D.R., 6:17394
Paul, W., Determination of PSEUDOGAP state density and carrier mobility in r.f. sputtered amorphous silicon. Quarterly technical progress report, July 1, 1979-September 30, 1979, 6:16643 (DOE/ET/23037—1)
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Pavel, G., *See* Hampel, V.E., 6:16878
Pawlewicz, W.T., High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers, 6:17890
Pearce, R.M., *See* Ahmad, S., 6:17736
Pearlman, H., *See* Powell, J.R., 6:17828
Pearlstein, S., *See* Bhat, M.R., 6:17273, 6:17681, 6:17682, 6:17683, 6:17685, 6:17737
Pedersen, R.A., *See* Brandriff, B., 6:17516
Peebles, W.A., CW far-infrared laser-scattering apparatus for plasma wave studies, 6:17812
Peker, L.K., Particle properties of collective states, 6:17714
Pelroy, R.A., *See* Macler, B.A., 6:17479
Pepper, D.W., Calculation of particulate dispersion in a design-basis tornadic storm from the Battelle Memorial Institute, Columbus, Ohio, 6:17383 (DP—1583)
Peraino, C., Phenobarbital effects on weight gain and circadian cycling of food intake and body temperature, 6:17536
Perdue, P.T., Cryogenic method for measuring nuclides and fission gases, 6:17323
Perey, F.G., *See* Lundy, J.C., 6:17686
Periasamy, N., Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO, 6:17188
Perkins, D.E., *See* Singleton, R.M., 6:17886
Perkins, F.W., *See* Caramana, E.J., 6:17784, 6:17817
Perkowitz, S., Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb, 6:17749 (DOE/ER/10436—2)
Perrine, R.L., *See* Hunsaker, D.B. Jr., 6:16636
Perry, G.E., Weeks Island S Sand Reservoir B gravity stable tertiary CO_2 displacement, Iberia Parish, Louisiana, 6:16476 (CONF-8004140—, pp 184-202)
Persnger, M.M., *See* Burkhardt, F.R., 6:16793
Peterfreund, A.R., Geology of magma systems: background and review, 6:16728 (SAND—80-1959)
Petermann, J., *See* Schultz, J.M., 6:17134
Peters, E.T., Quantitative separation of asbestos in environmental samples. Final report, August 1978-August 1979, 6:17344 (PB—80-219413)
Peters, R.D., *See* Westsik, J.H. Jr., 6:16567
Peterson, C.H., *See* Sun, C.C., 6:16799
Peterson, D.R., *See* Fowler, C.M., 6:17208
Peterson, J.H., *See* Wright, I.G., 6:16365
Peterson, J.R., *See* Coggiola, M.J., 6:17572
Petitt, G.A., Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)
Petrakis, L., *See* Cooper, B.R., 6:16400
Pette, K.C., *See* Sax, R.I., 6:16990
Phelps, M.E., Metabolic mapping of the brain's response to visual stimulation: studies in humans, 6:17515
Phillips, P.J., Effects of processing conditions on the reliability of cross-linked polyethylene cable insulation. Progress report, 6:17130 (DOE/ER/10421—T1)
Phillips, R.E., *See* Spore, J.W., 6:16862
Phillips, W.A., *See* Robison, W.L., 6:17422
Phipps, H.R. Jr., *See* Crowell, J.J., 6:17030
Pickering, H.W., Cluster formation and the elevated temperature strengthening of iron alloys by Ti, 6:17081 (CONF-800730—5)
See Kuk, Y., 6:17080, 6:17092, 6:17122
See Sakurai, T., 6:17082, 6:17093, 6:17094
Pierce, R.D., Advanced fuel-cell development. Progress report, January-March 1980, 6:16946 (ANL—80-67)
Pierson, H.O., Chemical vapor deposition of boron at low temperatures, 6:17144 (SAND—81-0475C)
Pietz, S., Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
Pilz, W., Scattering of 10 MeV neutrons by silicon, 6:17700 (DOE/NDC—21/L(Vol.1), pp 421-427)
Pincelli, R.D., Wood-coal fired small boiler case study, 6:16996 (CONF-800483—(Vol.2), pp 503-506)
Pincosy, P.A., *See* Levine, M.A., 6:17778
Pines, A., *See* Warren, W.S., 6:17617
Pirkle, F.L., *See* Koch, C.D., 6:16534
Pitzer, K.S., Dissociation energies of molecules with very heavy atoms from mass spectrometry, 6:17622
Placet, M., New source performance standards for industrial boilers. Volume 1. Analysis of fuel use implications, 6:17386 (ANL/EES-TM—103)
Platt, R.J., High-pressure slurry-letdown valve designs for Exxon Coal-Liquefaction Pilot Plant, 6:16359 (DOE/MC/14522—1, pp 6.1-6.6)
Platts, D.A., *See* Armstrong, W.T., 6:17785
Plemons, R.E., UCC-ND procedures for analyses of coal, Oak Ridge installations, 6:16399 (Y/DK—263)
Plotkin, M., ISABELLE cavity gap assemblies, 6:17285 (BNL—29091)
Plut, F., BI-GAS gasification process and valve requirements, 6:16364 (DOE/MC/14522—1, pp 13.1-13.13)
Podder, A., Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))
Podesto, B., Real-Time Digital Data-Acquisition System for determining load characteristics. Volume 2. Operating, programming, and maintenance instructions. Final report, 6:16808 (EPRI-EL—851(Vol.2))
Poe, R.T., *See* Kernan, A., 6:17642
Poeppel, R.B., *See* Pierce, R.D., 6:16946
Poletti, A.R., Nuclear structure of high-spin states in ^{46}Ti and ^{46}V, 6:17705
Policastro, A., Studies on mathematical models for characterizing plume and drift behavior from cooling towers. Executive summary, 6:17351 (EPRI-CS—1683-SY)
Pomeroy, L.R., Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981, 6:17429 (DOE/EV/00639—22)
Pong, W., *See* Brandt, D., 6:17154
Pope, L.E., Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
Poray, A.T., *See* Coultes, M.E., 6:16787
Porter, E.D., Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report, 6:16497 (PB—80-222482)
Porter, G.D., MFTF-B physics requirements, 6:17882 (UCID—18798)
Porter, N.J., *See* Corcoran, W.R., 6:16824
Post, D.E., *See* Stewart, L.D., 6:17592
Post, D.W., *See* McCulloch, R.W., 6:16845
Post, W.M., Evolution of mutualism between species, 6:17395 (CONF-800160—1)
Postma, A.K., *See* McCormack, J.D., 6:16872
Poteet, K.H., *See* Corbett, B.L., 6:16858
Potter, K.M., CERN LEP project, 6:17300 (SLAC—239, pp 309-327)
Potter, R.M., Apparatus and method for downhole injection of radioactive tracer, 6:17324
Poukey, J.W., *See* Miller, P.A., 6:17815
Poulsen, P., *See* Hooper, E.B. Jr., 6:17585
Powell, D.R., Crystal-structure determinations of Lu_5S_4, nonstoichiometric $Nb_{1.08}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)

Powell, J.R., Design studies of an aluminum first wall for INTOR, 6:17828 (BNL—29190)
See Botts, T.E., 6:16791
Prasad, A., Power generation from waste heat using organic Rankine cycle systems, 6:17012 (CONF-800483—(Vol.2), pp 637-642)
Prelec, K., *See* Alessi, J., 6:17827
Prichard, B., *See* Stewart, L.D., 6:17592
Pritz, P.M., *See* Butz, T.R., 6:16535, 6:16536
Prodell, A.G., *See* Allinger, J.E., 6:17263
See Hahn, H., 6:17297
Pruess, K., *See* Miller, C.W., 6:16753
Puetzstueck, H., *See* Mischke, H., 6:16912
Puglisi, M., Pulsed rf operation analysis, 6:17296 (BNL—29241)
See Luccio, A., 6:17289
Punwani, D.V., Peat dewatering: solvent extraction, 6:16609 (TR—80/031-001, pp 167-181)
Peat gasification: IGT work progress, 6:16607 (TR—80/031-001, pp 127-144)
Peat gasification: low-severity hydropyrolysis, 6:16610 (TR—80/031-001, pp 183-193)
Peat pretreatment: high-pressure wet carbonization, 6:16608 (TR—80/031-001, pp 145-165)
Putt, R.A., Development of zinc-bromine batteries for utility energy storage. Interim report, September 1978-August 1979, 6:16788 (EPRI-EM—1717)

Q

Qaim, S.M., Integral cross section measurements on (n,x) reactions induced by 30 MeV d(Be) break-up neutrons on FRT wall and structural materials, 6:17704 (DOE/NDC—21/L(Vol.2), pp 539-552)
Queirolo, A., *See* Lamontagne, J., 6:16926
Quinby-Hunt, M.S., *See* Jones, A.T., 6:17430

R

Raaen, V.F., *See* Benjamin, B.M., 6:16395
Rabe, J.A., Evaluation of silicone foam for flat plate solar collector insulation, 6:16722
Rabitz, H., *See* Demiralp, M., 6:17171
Radway, J.E., Practical considerations in controlling plume opacity on an oil-fired boiler, 6:16506
Ragland, K.W., Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978, 6:17384 (PB—80-205792)
Ragsdale, H.L., Ecological behavior and effects of energy-related pollutants. Progress report, November 1, 1979-January 31, 1981, 6:17531 (DOE/EV/02412—105)
Rahman, A., *See* Grest, G.S., 6:17752
Rai-Choudhury, P., *See* Hopkins, R.H., 6:16645
Rainbow, M.T., *See* Cierjacks, S., 6:17725
Rainer, F., *See* Milam, D., 6:17141
Rajan, J.B., Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
Rakovskii, V.E., Nitrogenous substances and means of studying the molecular structure of fuels, 6:16401 (ORNL-tr—4725)
Raley, J.H., *See* Ackerman, F.J., 6:16526
Ramachandran, R., Effect of H_2S on the hydrogenation and cracking of hexene over a CoMo catalyst, 6:16491
Ramakrishnan, N.R., Chemisorption of carbon monoxide on reduced molybdena, 6:17173
Ramsey, N.F., Dipole moments and parity violating spin rotations of the neutron, 6:17742 (SLAC—239, pp 559-572)
Randers-Pehrson, G., Neutron induced charged particle reaction studies at Ohio University, 6:17703 (DOE/NDC—21/L(Vol.1), pp 389-397)
Rando, R.R., Threshold effects and cellular recognition. Progress report, 6:17489 (DOE/EV/10268—1)
Randolph, P., *See* Foh, S., 6:16598
Rapaport, J., *See* Finlay, R.W., 6:17695
See Randers-Pehrson, G., 6:17703
Rapp, R.A., Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report, 6:17097 (DOE/ET/10404—2)
Rasch, D.M., *See* Rabe, J.A., 6:16722
Rattazzi, G.U., *See* Schmitt, R.P., 6:17711
Ravenscroft, D.S., *See* Kulke, B., 6:17283
Ray, R.R. Jr., Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2), pp 747-753)
Read, D.T., *See* Ekin, J.W., 6:17104
Reddoch, T.W., *See* Robinson, H.J. III, 6:16804
Reed, J.W., Cape Canaveral sea breezes, 6:17348
Reed, W.E., Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)
Titanium and titanium alloy creep. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17106 (PB—80-815244)
Reedy, R.P., Evaluation of fiber-optic connectors, 6:17213 (UCRL—53116)
Regimbart, R., *See* Schmitt, R.P., 6:17711
Reginato, L.L., Advanced Test Accelerator (ATA) pulse power technology development, 6:17282 (UCRL—85037)
Regnault, W., *See* Storti, G., 6:16662
Reid, K., Geothermal drilling fluid testing system, 6:16755 (SAND—79-7117, pp 27-40)
Reid, R.C., Liquefied natural gas gels: structure, rheology, and production energy requirements. Final report, January 1976-December 1979, 6:16521 (PB—80-210685)
LNG storage: safety analysis. Annual report for 1979, 6:16522 (PB—80-210750)
See Chang, H.R., 6:16498
Reider, J.P., Environmental assessment data systems user guide: Fine Particle Emissions Information System. Final report, September 1978-September 1979, 6:17905 (PB—80-222433)
Reiman, A., Minimum energy equilibria, 6:17870 (PPPL—1755, pp 189-192)
Reinbold, E.O., *See* Johnson, J.H., 6:16429
Reines, F., *See* Sobel, H.W., 6:17634
Reinhardt, C.L., *See* Belew, W.W., 6:16628, 6:16687, 6:16707, 6:16726
Reiser, M., Current limits in linear accelerators, 6:17250
Reiter, R.E., *See* Ruoff, C.W., 6:17018
Renne, D.S., *See* Sandusky, W.F., 6:16780
Repeta, L., *See* Thompson, P., 6:17295
Reuveny, Z., Regulatory coupling of nitrate and sulfate assimilation pathways in cultured tobacco cells, 6:17474
Reynolds, J.A., Energy-saving pumping systems in chemical plant design, 6:17028 (CONF-800483—(Vol.2), pp 796-798)
Rheaume, R.H., *See* Dickinson, T., 6:17267
Rhoton, N.O., Flyer sensitivity test, 6:17337 (MHSMP—81-09)
Ribe, F.L., *See* Meuth, H., 6:17791
Ricard, E., *See* Delaunay, M., 6:17586
Ricci, J.S., *See* Andrews, L.C., 6:17184
Rice, W.T. Jr., *See* Beard, J.N. Jr., 6:17035
Rice, W.W., *See* Shelton, R.N. Jr., 6:17608
Richard, G., *See* Ackerman, D.G., 6:17369
Richards, D., *See* George, J.F., 6:16684
Richardson, J.H., Etchback smear removal process characterization. Final report, 6:17237 (BDX—613-2598)
Richardson, S., *See* Walters, A., 6:16417
Riedinger, L.L., *See* Bingham, C.R., 6:17722
Ritchie, B.G., Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730
Ritschard, R., Technology assessments, 6:16889 (LBL—11972, pp 1.2-1.3)
Ritson, D., Instrumentation, 6:17741 (SLAC—239, pp 177-191)
Rivera, O., *See* Paciotti, M., 6:17281
Rizzo, T.G., Two-jet decay of particles with heavy quarks, 6:17665
Roback, J.J.., Coal gasification of a central heating plant, 6:16393
Roberts, D.A., *See* Miller, R.P., 6:16408, 6:16409
Roberts, E.H., *See* Zaikowski, A., 6:16537
Robertson, B.C., *See* Lone, M.A., 6:17691
Robertson, S., *See* Fisher, A., 6:17847
Robertus, R.J., *See* Mudge, L.K., 6:16654
Robichaud, Y., *See* Podesto, B., 6:16808
Robins, K., *See* Willen, E., 6:17288
Robinson, A.M., Plant energy-cost-optimization program (PECOP), 6:16991 (CONF-800483—(Vol.2), pp 459-465)
Robinson, C.V., Programs and subroutines for calculating cadmium body burdens based on a one-compartment model, 6:16854 (BNL—51306)
Robinson, H.J. III, Generalized model for electric distribution systems, 6:16804 (CONF-810433—1)
Robinson, J.N., Roofing research: a bibliography, 6:16967 (ORNL/TM—7629)
Robinson, R.A., *See* Miller, R.P., 6:16408, 6:16409
Robison, W.L., Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)

Robson, A.E., Linus reactor: compression of a compact torus by a liquid metal liner, 6:17873 (PPPL—1755, pp 208-211)
See Sethian, J.D., 6:17849
Rocco, J.C., *See* Delaunay, M., 6:17586
See Foucher, J.L., 6:17593
Rockar, E., *See* Foh, S., 6:16598
Rockett, P.D., Pulsed versus direct current calibration of a proximity focused x-ray streak camera, 6:17764 (LA—8425-MS)
Rodger, E.S., Improved copper septum magnet design, 6:17261 (BNL—29083)
Rodrigue, G., Influence of computer architectures on numerical algorithms, 6:17901 (UCRL—85679)
Roebuck, S., *See* Sgambat, J.P., 6:17436
Roeckl, E., Recent experiments at the GSI on-line separator, 6:17709
Rogers, P.S.Z., Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
Rogers, W.T., High-efficiency burners by retrofit: a simple inexpensive way to improve combustion efficiency, 6:16995 (CONF-800483—(Vol.2), pp 488-493)
Rohatgi, A., *See* Hopkins, R.H., 6:16645
Rohrer, J.W., Cost-effective waste-heat Organic Rankine Cycle application and systems designs, 6:17013 (CONF-800483—(Vol.2), pp 643-649)
Romero, C.M., *See* Zanelli, C.I., 6:17702
Romero, J.L., *See* Subramanian, T.S., 6:17694
Romney, E.M., Vegetation management and recovery at sites distrubed for solar thermal power systems development. Progress report for FY 1980, 6:16634 (UCLA—12-1281)
Rosdahl, A.R., *See* Zbasnik, J.P., 6:17887
Rose, J.G., *See* Chan, E.W., 6:17476
Rose, P.H., *See* Willenberg, H.J., 6:17879
Roseme, G.D., *See* Fisk, W.J., 6:16964
Rosenberg, A.H., *See* Studier, F.W., 6:17488
Rosenberg, H.S., Construction materials for wet scrubbers. Volume 2. Final report, 6:16406 (EPRI-CS—1736(Vol.2))
Construction materials for wet scrubbers. Final report, 6:16795 (EPRI-CS—1736(Vol.1))
Rosenberg, M., *See* Dominguez, R.R., 6:17805
Rosenblatt, L.S., *See* Fisher, G.L., 6:17493
Rosner, J.L., Heavy quarks and new particles, 6:17674 (DOE/ER/01764—382)
Ross, K.C., Use of task analysis in control room evaluations, 6:16852 (CONF-810411—, pp 165-174)
Ross, M.H., *See* Ganeriwal, R., 6:17029
Rossiter, W.J. Jr., *See* Weidt, J.L., 6:16965
Rostoker, N., *See* Fisher, A., 6:17847
Roth, M.G., Difference methods for stiff delay differential equations, 6:17896 (DOE/ER/02383—T2)
Rothman, A.C., Natural flavor conservation, 6:17670 (DOE/ER/01545—301)
Rouhiainen, P., *See* Kilpinen, U., 6:17050
Rousseau, R.W., *See* Ferrell, J.K., 6:16616
Rowell, R.L., Structure and stability of coal-oil mixtures and coal-water mixtures. Final report, 6:16455 (EPRI-CS—1695)
Rowlette, J.J., Electric and hybrid vehicles charge efficiency tests of ESB EV-106 lead-acid batteries, 6:17068 (DOE/CS/54209—T1)
Roy, G., *See* Levy, S., 6:16871
Rozsa, R., *See* Hoenig, C., 6:16571
Rozsa, R.B., *See* Tewhey, J.D., 6:16572
Ruberg, K., *See* Arens, E.A., 6:16973
Rubin, A.I., Lighting issues in the 1980's: summary and proceedings of a lighting roundtable held at New York, New York on June 14 and 15, 1979. Final report, 6:16975 (PB—80-222714)
Rubin, A.M., *See* Oliker, I., 6:17049
Ruderman, H., Regional studies, 6:16904 (LBL—11972, pp 1.26-1.28)
Rudy, T., Application program performance measurements, 6:17625 (UCRL—85677-VUGRAPH)
Rullhusen, P., Test of vacuum polarization by precise investigation of Delbrueck scattering, 6:17710
Ruoff, C.W., Industrial-boiler optimization utilizing CO control, 6:17018 (CONF-800483—(Vol.2), pp 688-694)
Rusnak, T., *See* Tomlinson, J., 6:16430
Rust, B.W., *See* Kirk, B.L., 6:17893
Ruth, R.D., Vertical fast blow-up in a single bunch, 6:17254 (BNL—29215)
Ruth, T.J., *See* Bloomer, W.D., 6:17514
Rutherford, W.M., Generalized computer model of the transient behavior of multicomponent isotope-separation cascades, 6:16550 (MLM—2816(OP))
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))
Ryan, M.T., Comparison of 50-year and 70-year internal-dose-conversion factors, 6:17744 (ORNL/TM—7415)
Ryan, P.M., *See* Tsai, C.C., 6:17583
Ryerson, F.J., *See* Tewhey, J.D., 6:16572

S

Saad, Y., *See* Gear, C.W., 6:17894
Sacher, G.A., Role of brain maturation and reproductive history in the evolution of the primate brain, 6:17500 (CONF-8004147—1)
See Hart, R.W., 6:17521
Sachs, R.G., Theoretical studies of high-energy phenomena: analysis of models of CP and T violation. Progress report, February 15, 1980-April 30, 1981, 6:17671 (DOE/ER/10587—1)
Sackinger, W.M., Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
Sadana, D.K., Transmission electron microscopy and Rutherford backscattering studies of single and double discrete buried damage layers in P^+ implanted Si on subsequent laser annealing, 6:17150
Sadler, J.W., MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Sain, L.H., *See* Davidson, J.N., 6:16820
Saito, K., *See* Nogi, Y., 6:17858
Saitoh, T., *See* Kusuda, T., 6:16974
Sakurai, T., Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981, 6:17094 (DOE/ER/10430—T1)
Observation of grain boundary segregation on an atomic scale in a Fe-0.04% P alloy by atom-probe FIM, 6:17093 (DOE/ER/10430—9)
Phosphorus segregation to grain boundaries in a Fe-0.04% P alloy, 6:17082 (CONF-800730—6)
See Kuk, Y., 6:17080, 6:17092, 6:17122
See Pickering, H.W., 6:17081
Salazar, P.H., *See* Anderson, D.M., 6:17511
Salmon, R., Technical and economic evaluation of selected coal-liquefaction processes. Phase O. Preliminary screening evaluations, 6:16384 (ORNL/TM—7581)
Samurin, N.A., Fluid catalytic-cracking power-recovery dynamic computer simulation, 6:17010 (CONF-800483—(Vol.2), pp 622-629)
Sanda, A.I., *See* Carter, A.B., 6:17673
Sandberg, B.R., Novel current monitor for DC and modulated magnets in the proton storage ring, 6:17299 (LA-UR—81-781)
Sandberg, S., Documentation and analysis of the Schlumberger interactive 1-D inversion program slumb, 6:16730 (DOE/ET/27002—2)
Sander, O., Redesign of the LAMPF transition region, 6:17258 (LA-UR—81-737)
Sanders, D.M., *See* Haller, W., 6:17118
Sanders, R., *See* Gammel, G., 6:17271
Sanderson, J.E., *See* Levy, P.F., 6:16605
Sandford, S., *See* Paciotti, M., 6:17281
Sandholtz, W.A., *See* Ackerman, F.J., 6:16526
Sands, M.D., *See* Sullivan, S.M., 6:16686
Sandusky, W.F., Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Sanford, A.R., Seismic exploration for shallow magma bodies in the vicinity of Socorro, New Mexico. Final report, January 1, 1977-December 31, 1977, 6:16741 (NP—25336)
Santhanam, C.J., Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979, 6:16410 (PB—80-222409)
Santos, S., *See* Alberi, G., 6:17687
Santry, D.C., *See* Lone, M.A., 6:17692
Sanyal, S.K., *See* Luengo-C, J.R., 6:16485
Sargent, D.H., Effect of physical coal cleaning on sulfur content and variability. Final report, June 1978-April 1980, 6:16385 (PB—80-210529)
Sargent, T.O., Towards accurate emergency response behavior, 6:16823 (CONF-810411—, pp 183-197)
Sato, T., *See* Okabayashi, M., 6:17864
Saucier, A.E., *See* Adams, S.S., 6:16533
Sauer, K., Photosynthesis: the light reactions, 6:17485
See Frank, H.A., 6:17483, 6:17498
Savage, W.F., Localized corrosion and stress-corrosion cracking behavior of stainless steel weldments. Annual progress report, June 1, 1980-

February 28, 1981, 6:17087 (DOE/ER/02462—T1)
Sawyer, R.H., Organic Rankine Cycle System: its application to extract energy from low-temperature waste heat, 6:17011 (CONF-800483—(Vol.2), pp 630-636)
Sax, R.I., Production of biogas from waste waters of food-processing indusries, 6:16990 (CONF-800483—(Vol.2), pp 441-447)
Saxler, R.J., *See* Weidt, J.L., 6:16965
Sayegh, S.G., Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—, pp 166-183)
Sayer, J., *See* Berk, H.L., 6:17789
Sayre, E.V., *See* Kaplan, M.F., 6:17156
Scanlan, R.M., *See* Zbasnik, J.P., 6:17887
Scarlata, D.S., *See* Welsh, L.B., 6:16952
Schaa, V., *See* Strehl, P., 6:17284
Schaefer, H.F. III, *See* Chen, M.M.L., 6:17155
See Laidig, W.D., 6:17613
Schaffel, N., *See* Gay, T.J., 6:17605
Schardt, M.A., Measurement of the decay rate of the Dalitz decay of the neutral pion, 6:17649
Schatzberg, E., *See* Kennish, W., 6:16959
Schechter, D.E., *See* Tsai, C.C., 6:17583
Schectman, R.M., *See* Gay, T.J., 6:17605
Scheiner, B.J., *See* Smelley, A.G., 6:17423
Scheld, H.W., Chinese tallow tree as a cash and petroleum-substitute crop, 6:16659 (SERI/CP—622-1086, pp 97-111)
Schlafke, A.P., *See* Schneider, W.J., 6:17294
Schlepp, D.R., Use of an open-cycle absorption system for heating and cooling, 6:16703 (SERI/TP—631-1159)
Schlue, J., *See* Sanford, A.R., 6:16741
Schmid, F., Silicon ingot casting - heat exchanger method (HEM); multi-wire slicing - fixed abrasive slicing technique (FAST). Phase IV. Silicon sheet growth development for the Large Area Sheet Task of the Low-Cost Solar Array Project. Quarterly progress report No. 4, October 1-December 31, 1980, 6:16646 (DOE/JPL/954373—80/18)
Schmidt, C., *See* Weng, W.T., 6:17265
Schmidt, C.W., Operation of the Fermilab H^- magnetron source, 6:17581 (BNL—51304, pp 189-193)
Schmidt, D., *See* Pilz, W., 6:17700
Schmidt, J.A., *See* Stewart, L.D., 6:17592
Schmidt, J.S., *See* Koch, C.D., 6:16534
Schmidt, R.A., *See* Warpinski, N.R., 6:16520
Schmied, H., Determination of residual oil saturation in drilling project Maustrenk DF 1 by routine core analyses and relative permeabilities, 6:16469 (CONF-8004140—, pp 25-40)
Schmitt, R.C., *See* Sha, W.T., 6:16724
Schmitt, R.P., Fast-particle emission in the deep-inelastic reaction Cu + ^{20}Ne at 12.6 MeV/nucleon, 6:17711
Schnack, D.D., *See* Berk, H.L., 6:17789
See Shestakov, A.I., 6:17790
Schneider, W.J., First cell magnet system tests, 6:17294 (BNL—29232)
Schoeller, D.A., Fecal ^{13}C analysis for the detection and quantitation of intestinal malabsorption, 6:17495
Schramm, D.N., Neutrinos and cosmology, 6:17562 (SLAC—239, pp 601-615)
Schramm, R.E., *See* Ekin, J.W., 6:17104
Schreiber, J.D., *See* Foh, S.E., 6:16594
Schriebman, J.A., *See* Hampel, V.E., 6:16878
Schrodt, J.T., Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))
Schroeder, J.E., *See* Lindsey, K.E., 6:16809
Schroeder, W.U., *See* Hilscher, D., 6:17719
See Mignerey, A.C., 6:17708
Schuller, I.K., *See* Zheng, J.Q., 6:17111
Schultheis, M.C., *See* Waring, K., 6:16492, 6:16493
Schultz, J.M., Annealing of polypropylene films crystallized from a highly extended melt, 6:17134
Schultz, K.R., *See* Carlson, G.A., 6:17876
See Smith, A.C. Jr., 6:17877
Schumacher, M., *See* Rullhusen, P., 6:17710
Schware, R., *See* Kellogg, W.W., 6:17448
Schwartz, A.M., Thermal denaturation of chromatin and lysine copolymer-DNA complexes. Effects of ethylene glycol, 6:17480
Schwartz, L.H., *See* Butt, J.B., 6:17089
Schwarzenegger, K.F., *See* Ikezi, H., 6:17867
Schwent, V., *See* Hirsch, E., 6:16771
Sciamanna, S.F., *See* Hulseman, R.A., 6:16382
Sciulli, F., Neutrinos and neutrino interactions, 6:17659 (SLAC—239, pp 29-66)
Scoles, R.G., *See* Terry, J.M., 6:16495
Scott, A.J., *See* Wessol, D.E., 6:17836
Scott, B.R., *See* Cuddihy, R.G., 6:17452
Scott, D.K., *See* Doll, P., 6:17697
Seager, C.H., Studies of the hydrogen passivation of silicon grain boundaries, 6:17153
Sealock, L.J. Jr., *See* Mudge, L.K., 6:16654
Seamons, L.O., *See* Holmes, J.T., 6:16717
Secrest, T.J., *See* Nieves, L.A., 6:16976
Sedlacek, W.A., *See* Berg, W.W., 6:17566
Seeliger, D., *See* Pilz, W., 6:17700
Seidl, M., Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304, pp 111-118)
Seiler, F.A., *See* Cuddihy, R.G., 6:17452
Selkirk, J.K., *See* MacLeod, M.C., 6:17473
Semet, A., *See* Peebles, W.A., 6:17812
Semtner, A.J. Jr., *See* Washington, W.M., 6:17347
Sermet, P., *See* Delaunay, M., 6:17586
See Foucher, J.L., 6:17593
Serpa, L.F., Terrain correction program for gravity data: user's guide and documentation for Rev. 0), 6:17548 (DOE/ID/12079—26)
Seskus, A.P., Relationship between photolineaments and Devonian shale gas well productivity; with application to testing of DuPont EL-836 explosive, 6:16517 (DOE/MC/08216—140)
Sethian, J.D., Reversed-field configuration with rotating relativistic electron beams, 6:17849 (PPPL—1755, pp 37-40)
SethuRaman, S., Marine boundary layer wind structure over the Bay of Bengal during MONEX79, 6:17342 (BNL—29260)
Setlow, J.K., How the NIH recombinant DNA Molecule Committee works in 1979, 6:17499
Setlow, R.B., *See* Achey, P.M., 6:17522
Severson, S.D., *See* Augustine, F., 6:16794
Sevilla, M.D., *See* Suryanarayana, D., 6:17176
Sexton, N.G., Compilation of environmental assessment data, February 1978-March 1979. Volume I. Studies 1-7. Final report, February 1978-March 1979, 6:17363 (PB—80-219546)
Compilation of environmental assessment data, February 1978-March 1979. Volume II. Studies 8 and 9. Final report, February 1978-March 1979, 6:17364 (PB—80-219553)
Compilation of environmental assessment data, February 1978-March 1979. Volume III. Studies 10-14. Final report, February 1978-March 1979, 6:17365 (PB—80-219561)
Seyler, C.E., *See* Barnes, D.C., 6:17787
Sgambat, J.P., Effects of underground coal mining on ground water in the eastern United States. Final report, September 1976-September 1979, 6:17436 (PB—80-216757)
Sha, W.T., COMMIX-SA-1: a three-dimensional thermohydrodynamic computer program for solar applications, 6:16724 (ANL—80-8)
Shackelford, J.F., *See* Stroud, R.D., 6:17109
Shaikh, Z.A., *See* Tohyama, C., 6:17525
Shanes, L.M., *See* Reid, R.C., 6:16521
Sharitz, R.R., *See* Gibbons, J.W., 6:17444
Shatynski, S.R., *See* MacCrone, R.K., 6:17117
Shaver, R.J., *See* Magid, L.J., 6:16465
Shaw, B.J., Contract WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9, second annual report, January 1-December 31, 1980, 6:17098 (DOE/ET/13513—T8)
WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9. Second annual report, January 1-December 31, 1980, 6:17099 (DOE/ET/13513—T9)
Shearer, J.W., Reconnection conditions for flowing field-reversed plasma from a plasma gun, 6:17852 (PPPL—1755, pp 61-64)
Sheen, E.M., *See* Gold, R., 6:16841
Sheffield, G., *See* Okabayashi, M., 6:17864
See Yamada, M., 6:17865
Sheldon, D.B., Heat pumps and utility-interactive photovoltaic power systems, 6:16668 (DOE/ET/20279—120)
Shelton, R.N. Jr., Temperature-controlled cell for laser-induced fluorescence and absorption studies, 6:17608
Shen, S., Energy and materials flows in the production of liquid and gaseous oxygen, 6:16986 (ANL/CNSV—15)
Shepard, R.L., *See* Blalock, T.V., 6:17325
Sherwood, A.R., *See* Jarboe, T.R., 6:17777
Sherwood, E.G., *See* Armstrong, W.T., 6:17785
Shestakov, A.I., Tilting mode in the reversed-field theta pinch, 6:17790 (PPPL—1755, pp 126-129)
Shetty, D.K., *See* Wright, I.G., 6:16365
Shigemitsu, J., Comparing O(N) and SU(N) x SU(N) spin systems in 1 + 1

dimensions to SU(N) gauge theories in 3 + 1 dimensions, 6:17675 (DOE/ER/03130—T1)
Study of Λ parameters and crossover phenomena in SU(N) x SU(N) sigma models in two dimensions, 6:17676 (DOE/ER/03130—T2)
Shiina, S., *See* Nogi, Y., 6:17858
Shinn, J.H., Observed turbulence intensities in a desert boundary layer, 6:17345 (UCRL—84672)
Shirland, F.A., *See* Szedon, J.R., 6:16660
Shirley, E.C., *See* Squires, B.T., 6:17359
Shiroko, K., Practical approach to process analysis and improvement for energy conservation, 6:17026 (CONF-800483—(Vol.2), pp 782-790)
Shiu, K.K., Thermal-performance study of liquid metal fast breeder reactor insulation, 6:16837 (ANL—80-97)
Shore, B.W., Coherence in laser excitation, 6:17221 (UCRL—84260)
Effects of hyperfine structure on coherent excitation, 6:17602
Short, F., *See* Thompson, P., 6:17295
Shugart, H.H. Jr., *See* Van Voris, P., 6:17398
Shultz, E.B. Jr., *See* Scheld, H.W., 6:16659
Shultz, P.A., *See* Blue, L.A., 6:16831
Shumaker, D., *See* Auerbach, S.P., 6:17780
Shumway, R.W., *See* Spore, J.W., 6:16862
Shwartz, J., Fluid mechanics of fusion lasers. Final report, September 11, 1978-June 5, 1980, 6:17220 (DOE/DP/40070—1)
Sibbett, B.S., *See* Christensen, O.D., 6:16735
Sidener, J., *See* Twiss, R., 6:16745
Siegel, B.A., *See* Kumar, B., 6:17494
Siemon, R.E., FRX-C and multiple-cell experiments, 6:17786 (PPPL—1755, pp 106-109)
Sievers, A.J., CO_2 laser absorption and saturation studies of molecular impurities in alkali halide crystals, 6:17138 (DOE/DP/40013—1)
See Trotter, D.M. Jr., 6:16711
Sill, W.R., *See* Chu, J.J., 6:16731
Silviera, D.J., Potential influence of organic compounds on the transport of radionuclides from a geologic repository. Assessment of effectiveness of geologic isolation systems, 6:16580 (PNL—3414)
Sim, J.W., *See* Pierce, R.D., 6:16946
Simmons, M.A., *See* Cushing, C.E., 6:17524
Simon, M.N., *See* Studier, F.W., 6:17488
Simone, G.A., Bicycle Promotion Plan, 6:16981 (DOE/IR/10999—1)
Simpson, R.E., Inorganic cement for mine roof-bolt grouting, 6:16423 (BM-RI—8494)
Sinclair, D.K., *See* Shigemitsu, J., 6:17675
Sine, G.C., Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)
Singer, C.E., *See* Stewart, L.D., 6:17592
Singer, G.L., *See* Spore, J.W., 6:16862
Singer, J.J., Hydrographic observations off Savannah and Brunswick, Georgia: March, May and September 1977 and January 1978. Technical report 80-1, 6:17557 (DOE/EV/00889—7(Vol.3))
See Atkinson, L.P., 6:17556
Singh, S., *See* Cernansky, N.P., 6:17203
Singh, S.P.N., *See* Salmon, R., 6:16384
Singleton, R.M., System for automatic x-ray-image analysis, measurement, and sorting of laser fusion targets, 6:17886 (UCRL—84549)
Sinnis, J., *See* Yamada, M., 6:17865
Sinnott, M.V., Red-tagging safety procedure for a steam distribution system, 6:17233
Sishtla, C., *See* Hirsan, I., 6:17239
Sivasubramanian, R., *See* Ying, D.H.S., 6:16352, 6:16353
Skelton, J.C., *See* Bates, F.J., 6:17834, 6:17835
Skudneski, L.A., Conservation: an in-plant energy resource, 6:17031 (CONF-800483—(Vol.2), pp 847-854)
Slaga, T.J., *See* MacLeod, M.C., 6:17473
Sledz, J.J., Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
Slunga, R., Swedish earthquakes and acceleration probabilities, 6:17549 (FOA-C—20295-E4)
Sluyters, T., *See* Alessi, J., 6:17827
Sluyters, T.J.M., Proceedings of the second international symposium on the production and neutralization of negative hydrogen ions and beams, 6:17567 (BNL—51304)
Smailos, E., *See* Hauser, W., 6:16575
Smalley, W.M., *See* Forrest, L., 6:17061
Smelley, A.G., Dewatering of industrial clay wastes, 6:17423 (BM-RI—8498)
Smend, F., *See* Rullhusen, P., 6:17710
Smith, A., Measured and evaluated bismuth cross sections for fusion-fission hybrid reactors, 6:17726 (DOE/NDC—21/L(Vol.2), pp 799-813)
Smith, A.B., 10 to 50 MeV neutron cross sections: an overview of accomplishments in the context of the 1977 Symposium, 6:17684 (DOE/NDC—21/L(Vol.1), pp 61-71)
Smith, A.C. Jr., Moving-ring field-reversed mirror reactor concept, 6:17877 (PPPL—1755, pp 224-227)
See Carlson, G.A., 6:17876
See Turner, W.C., 6:17845
Smith, D.G., *See* Paton, D.L., 6:16768
Smith, D.L., *See* Smith, A., 6:17726
Smith, E.M., *See* Peters, E.T., 6:17344
Smith, G., *See* Hoenig, C., 6:16571
Smith, G.B., Black chromium-molybdenum: a new stable solar absorber, 6:16721
Smith, J., *See* Dunbar, D., 6:17393
Smith, J.D., *See* Bozoki, E., 6:17266
Smith, J.F., *See* Kandil, H.M., 6:17151
Smith, J.L., *See* Pierce, R.D., 6:16946
Smith, K.A., *See* Reid, R.C., 6:16522
Smith, L., *See* Lambertson, G., 6:17260
Smith, M., EPA utility FGD survey: January-March 1980. Quarterly report, 6:16796 (PB—80-211832)
Smith, R.B., *See* Wechsler, D.J., 6:16733
Smith, R.E., *See* Hinerman, K.B., 6:17419
Smith, S.A., Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
Smith, S.D., *See* Gordon, H.A., 6:17318
Smith, T.M., *See* Stoenescu, M.L., 6:16945
Smookler, M., *See* Sullivan, S.M., 6:16686
Smyth, J.R., *See* McGee, T.D., 6:16370
Smythe, T.J., *See* Waring, K., 6:16492, 6:16493
Snow, S.G., *See* Giacomelli, E.J., 6:17321
Snyder, S.D., *See* McCulloch, R.W., 6:16845
Snyder, W.T., *See* Jendrucko, R.J., 6:17024
Sobel, H.W., Neutrino instability, 6:17634 (SLAC—239, pp 441-456)
Soderstrom, J., *See* Hirst, E., 6:16962
Solomon, A.D., *See* Alexiades, V., 6:16880
Solomon, P.R., *See* Hamblen, D.G., 6:16398
Sonderman, J., New photographic technique for observing bulk laser damage, 6:17078 (UCRL—84843)
Songkran, B., *See* Morrow, N.R., 6:16470
Sorensen, C.M., *See* Lester, T.W., 6:17201
Southerland, L.I., *See* Sexton, N.G., 6:17363, 6:17364, 6:17365
Spector, D.N., *See* Sethian, J.D., 6:17849
Spejewski, E.H., *See* Ritchie, B.G., 6:17730
Spells, S., *See* Rabe, J.A., 6:16722
Spitler, L.E., *See* Fisher, G.L., 6:17493
Spore, J.W., TRAC-BD1: transient reactor analysis code for boiling-water systems, 6:16862 (CONF-810307—3)
Squires, B.T., Transportation systems and regional air quality - photochemiCal modeling of Sacramento, California region. Interim report, April 1976-October 1979, 6:17359 (PB—80-210800)
Stachowiak, R.V., *See* Handley, G.R., 6:17214
Staffel, G., *See* Vonach, H., 6:17712
Stallings, T.L., *See* Osborn, A.G., 6:17336
Stanley, T.D., Measurement of magnetically insulated line voltage using a Thomson Parabola Charged Particle Analyser, 6:17881 (SAND—80-2685C)
Staples, J., *See* Lambertson, G., 6:17260
Staten, H.S., US negative ion neutral beam development program, 6:17590 (BNL—51304, pp 315-320)
Steele, N.W., Education and training promote energy conservation, 6:17055 (CONF-800483—(Vol.2), pp 760-765)
Steinhauer, L.C., Plasma rotation in field-reversed theta pinches, 6:17793 (PPPL—1755, pp 151-154)
See Willenberg, H.J., 6:17879
Steinmetz, G.F., Novel approach to field testing shunt-flow steam meters, 6:17039
Stelts, M.L., *See* McCullagh, C.M., 6:17739
Stephan, J.P., *See* Bacal, M., 6:17588
Stevens, P., *See* Goldburg, A., 6:16479
Stewart, H.B., Overview of multifluid-flow-calculation methods, 6:17224 (BNL—29189)
Stewart, L.D., Merits of D^--based neutral beam injectors for tokamaks, 6:17592 (BNL—51304, pp 321-329)
Sticksel, P.R., *See* Barrett, R.E., 6:17245
Stinnett, R.W., *See* Stanley, T.D., 6:17881
Stinton, D.P., *See* Caputo, A.J., 6:16552
Stirling, W.L., *See* Tsai, C.C., 6:17583
Stix, T.H., Holomak: a toroidal spheromak, 6:17872 (PPPL—1755, pp 204-207)
See Yamada, M., 6:17865

Stock, L.M., Coal-transformation chemistry. Fourth quarterly progress report, 6:16371 (DOE/PC/30088—4)
Stockman, H.S., *See* Szkody, P., 6:17564
Stodt, J.A., Telluric-magnetotelluric method in two- and three-dimensional environments, 6:16732 (DOE/ET/28392—25)
Stoenescu, M.L., Theoretical analysis of ARC constriction, 6:16945 (DOE/ET/15422—6)
Stokowski, S., *See* Sonderman, J., 6:17078
Stoll, M.E., Simple, fast recovery, low-noise receiver amplifier for pulsed NMR experiments, 6:17334
Stolwijk, J.A.J., *See* Leaderer, B.P., 6:17349
Stone, J., *See* Mayo, M., 6:17576
Stonehart, P., Stability of acid-fuel-cell cathode materials. Work period: January 1, 1978-December 31, 1979, 6:16950 (EPRI-EM—1664)
Stonesifer, R.B., *See* Kanninen, M.F., 6:16849
Storti, G., Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980, 6:16662 (SERI/TR—8272-1-T1)
Strachan, D. M., *See* Babad, H., 6:16574
Strachan, J.D., Fusion neutron production during deuterium neutral-beam injection into the PLT tokamak, 6:17819
See Chrien, R.E., 6:17688
Strand, R.H., *See* Waterhouse, J.C., 6:17428
Strathman, M., *See* Sadana, D.K., 6:17150
Strauss, J.B., *See* Sargent, D.H., 6:16385
Streeter, R.C., Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980, 6:16354 (DOE/ET/14815—20)
Strehl, P., Phase probe measuring system in the UNILAC: probe dimensioning and signal evaluation, 6:17284 (LA-tr—80-43)
See Glatz, J., 6:17276
Streil, T., *See* Pilz, W., 6:17700
Strong, S.J., Solar photovoltaic residence in Carlisle, Massachusetts, 6:16671 (DOE/ET/20279—129)
Stroud, R.D., X-ray diffraction study of residual stress in model weldments. Final report, 6:17109 (UCRL—15332)
Strovink, M., Possible deviations from (V-A) charged currents: precise measurement of muon decay parameters, 6:17631 (LBL—12275)
Strowd, W.B., Review of the upper Cenozoic stratigraphy overlying the Columbia River Basalt Group in western Idaho, 6:17545 (RHO-BWI-C—87)
Strunk, H., *See* Cunningham, B., 6:16647
Studier, F.W., Genetic and physical mapping in the early region of bacteriophage T7 DNA, 6:17488
Stuiver, M., *See* Burk, R.L., 6:17517
Sturtevant, B., *See* Shwartz, J., 6:17220
Subramanian, T.S., Neutron-induced charged particle measurements from carbon, nitrogen, and oxygen at UC, Davis, 6:17694 (DOE/NDC—21/L(Vol.1), pp 331-341)
Suckewer, S., Radiation losses in PLT during neutral beam and ICRF heating experiments, 6:17797 (PPPL—1768)
Sudan, R.N., *See* Dreike, P.L., 6:17813
See Greenly, J.B., 6:17848
See Reiman, A., 6:17870
Suenaga, M., Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Sugiyama, K., *See* Hino, Y., 6:17696
Sullivan, R., Unified interzone and system coupling methodology for building energy analysis. Final report, 6:16961 (DOE/SF/10840—T1)
Sullivan, R.G., *See* Halter, J.M., 6:17416
Sullivan, S.M., Draft environmental assessment: Ocean Thermal Energy Conversion (OTEC) Pilot Plants, 6:16686 (LBL—12328)
Sullivan, T.J., Atmospheric release advisory capability, 6:17381 (CONF-791234—, pp 15-33)
Sun, C.C., Experimental/engineering support for EPA's FBC program: final report. Volume III. Solid residue study. Final report, January 1977-December 1978, 6:16799 (PB—80-219256)
Sun, Y., *See* Chuang, K.C., 6:16392
Sunier, J.W., *See* Cizewski, J.A., 6:17729
Supalla, R.J., *See* Lansford, R.R., 6:16777
Suryanarayana, D., INDO study of the anion radicals of acetic acid and acetamide. Nonplanarity and barriers to methyl group rotation, 6:17176
Suyderhoud, J.P., *See* Kamins, R.M., 6:16932
Swannack, C.E., *See* Elliott, J.C., 6:17280
Swanson, B.I., Matrix—molecule interactions, dynamics, and exchange phenomena in low temperature matrices: SF_6 in argon and krypton, 6:17609
See Jones, L.H., 6:17610
Swanson, G.D., Finite-element-method study of stresses on simulated electronic components encapsulated in polystyrene-bead foam, 6:17236 (BDX—613-2551)
Swanson, J.E., *See* Hampel, V.E., 6:16878
Sweedler, A.R., *See* Lambert, S.E., 6:17135
Sweeney, M.A., High-gain, low-intensity ICF targets for a charged-particle beam fusion driver, 6:16587
Swinhoe, M.T., *See* Cierjacks, S., 6:17725
Sybert, L., *See* Folz, D.J., 6:16447
Sykes, L.R., Rupture zones of great earthquakes in the Alaska-Aleutian arc, 1784 to 1980, 6:17551
Sykes, R.M., Full scale field demonstration of unheated anaerobic contact stabilization. Quarterly project status report, July 1980-September 1980, 6:16603 (DOE/CS/24310—2)
Symonds, F.W., *See* Jendrucko, R.J., 6:17024
Symons, T.J.M., *See* Doll, P., 6:17697
Szedon, J.R., Development of copper sulfide/cadmium sulfide thin-film solar cells, 6:16660 (SERI/PR—8143-1-T3)
See Biter, W.J., 6:16641
See Temofonte, T.A., 6:16644
Szekely, J., Basic study of heat flow in fusion welding. Progress report, March 1, 1980-February 28, 1981, 6:17088 (DOE/ER/04799—2)
Szkody, P., AM Herculis: simultaneous x-ray, optical, and near-ir coverage, 6:17564

T

Taber, J.J., *See* Heller, J.P., 6:16488
See Orr, F.M. Jr., 6:16489
Tajima, T., Second-order quantum-chromodynamic effect in J/psi photoproduction, 6:17662
Takahashi, H., Fission reaction in high energy proton cascade, 6:17731 (DOE/NDC—21/L(Vol.1), pp 133-145)
Takata, A.M., *See* Ackerman, D.G., 6:17369
Talbert, W.L. Jr., Decay of ^{90}Rb/sup g/ and ^{90}Rb/sup m/, 6:17715
Tallerico, P.J., Status of the Los Alamos gyrocon, 6:17279 (LA-UR—81-772)
Tamor, S., Studies of emission and transport of synchrotron radiation in tokamaks, 6:17769 (LAPS—71)
Tanaka, K., *See* Milton, K., 6:17654
Tang, T.E., Effects of sulfur-containing gases on the performance of molten carbonate fuel cells, 6:16951 (EPRI-EM—1699)
Tannenbaum, M., *See* Thompson, P., 6:17295
Tanner, R.L., *See* Leaderer, B.P., 6:17349
Tarpley, W.B. Jr., Efficient ultrasonic grinding: a new technology for micron-sized coal. Final report, September 15, 1979-December 14, 1980, 6:16445 (DOE/ER/10466—1)
Taska, J., *See* Turner, W.C., 6:17845
Tatar, J., *See* Alston, T.G., 6:16987
Tate, M., *See* Griffin, T., 6:16775
Tawil, J.J., *See* Nieves, L.A., 6:16976
Taylor, C., *See* Kissell, F., 6:16424
Taylor, R.I., Role of the FLEXICOKING process in heavy-oil processing, 6:16490 (CONF-800483—(Vol.2), pp 799-804)
Temofonte, T.A., Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980, 6:16644 (DOE/ET/23106—4)
Templeton, D.H., Polarized x-ray absorption and double refraction in vanadyl bisacetylacetonate, 6:17174
Templeton, L.K., *See* Templeton, D.H., 6:17174
Terris, B.D., *See* Miller, W.M., 6:17216
Terry, J.M., Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)
Terwilliger, K.M., Acceleration of polarized protons in the Brookhaven AGS, 6:17255 (BNL—29295)
Teufel, L.W., Hydraulic-fracture propagation in layered rock: experimental studies of fracture containment, 6:16519 (SAND—80-2219C)
Tewhey, J.D., Application of SYNROC to high-level defense wastes, 6:16572 (UCRL—85032)

Teynen, P., Wet chemical method for the production of synthetic raw materials and homogeneous powders for physical-chemical studies, 6:17167 (IS-Trans—111)
Thacker, H.B., Exact integrability in quantum field theory and statistical systems, 6:17678
Themelis, M.P., *See* Forman, S.E., 6:16670
Thiel, S.W., *See* Salmon, R., 6:16384
Thilly, W.G., *See* Kaden, D.A., 6:17537
Thomas, E.L., Education and training of the shift technical advisor, 6:16818 (CONF-810411—, pp 83-88)
Thomas, J.K., *See* Almgren, M., 6:17190, 6:17191
Thomas, J.M., *See* Cushing, C.E. Jr., 6:17439
Thomas, L.E., Microanalysis of light elements with an ultrathin window x-ray spectrometer, 6:17327 (HEDL-SA—2122-FP)
Thomas, M.M., High pressure study of viscosity effects on the luminescence of tetracyanobenzene EDA complexes, 6:17179
Thomas, N., *See* Sonderman, J., 6:17078
Thomas, R.F., *See* Henningson, J.C., 6:17427
Thomas, R.H., *See* McCaslin, J.B., 6:17743
Thomas, S.K., Commercial and industrial energy conservation programs in Illinois, 6:17023 (CONF-800483—(Vol.2), pp 731-733)
Thomassen, K.I., Flexibility of MFTF-B for thermal-barrier modifications and axisymmetric upgrades, 6:17884 (UCID—18948)
See Porter, G.D., 6:17882
Thompson, G.H., Soil decontamination at Rocky Flats Plant, 6:17410 (CONF-791234—, pp 104-109)
Thompson, H.R. Jr., *See* Chrien, R.E., 6:17688
Thompson, J.K., *See* Leonard, B.R. Jr., 6:17733
Thompson, P., Mechanical properties of ISABELLE superconducting coils, 6:17295 (BNL—29236)
Thompson, P.E, *See* Patel, G. L., 6:17487
Thomson, J.J., *See* Christensen, T.E., 6:17830
Thordarson, O., Aggregation of deaths from ischaemic heart disease among first and second degree relatives of 108 males and 42 females with myocardial infarction, 6:17501
Thorn, C.E., *See* Baltz, A.J., 6:17251
Thorson, I.M., *See* Fraser, J.S., 6:17732
Thorson, M.R., Phantom position dependence, 6:17312 (PNL—3536, pp 7.1-7.26)
Statistical and low dose response, 6:17315 (PNL—3536, pp 10.1-10.56)
See Endres, G.W.R., 6:17305, 6:17306, 6:17307, 6:17308
Tiee, J.J., *See* Shelton, R.N. Jr., 6:17608
Tillery, M.I., Determination of protection factors for tandem HEPA filters, 6:17354 (LA-UR—81-729)
Ting, S.C., *See* Stodt, J.A., 6:16732
Tira, J.S., Low-temperature curing of a nitrile-epoxy adhesive. Final report, 6:17136 (BDX—613-2553)
Tobler, R.L., *See* Ekin, J.W., 6:17104
Toburen, L.H., *See* Manson, S.T., 6:17623
Todd, A., *See* Okabayashi, M., 6:17864
Todd, A.M.M., *See* Stix, T.H., 6:17872
See Yamada, M., 6:17865
Tohyama, C., Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)
Tollin, G., Mechanisms of photochemical energy conversion by chlorophyll. Progress report, April 1, 1980-March 30, 1981, 6:17467 (DOE/ER/04927—T2)
See Cheddar, G., 6:16640
See Ford, W.E., 6:17466
See Hurley, J.K., 6:17468
Tome, C., *See* Harrison, W., 6:17433
Tomita, Y., *See* Mohri, A., 6:17844
Tomita, Y., Experiment on plasma confinement by intense relativistic electron beam ring, 6:17775 (PPPL—1755, pp 20-25)
Tomlin, W., Saving money through employee motivation and participation in energy conservation, 6:17022 (CONF-800483—(Vol.2), pp 725-730)
Tomlinson, G., *See* Gray, D., 6:16347
Tomlinson, J., Splice testing using a figure-s machine and a new shuttle car simulation. Open file report, 1 May 1978-30 April 1979, 6:16430 (PB—80-210222)
Tomozawa, M., Properties of glasses with high water content. Progress report, 1 March 1980-31 January 1981, 6:17123 (DOE/ER/10453—2)
Tomozawa, Y., Proton decay rate, 6:17668
Toomey, J.E., Methods and costs for soil removal, 6:17414 (CONF-791234—, pp 171-175)
Project planning approach, 6:17450 (CONF-791234—, pp 167-170)
Torkelson, L., 1980 annual report of the Coolidge Solar Irrigation Project, 6:16679 (SAND—80-2378)
Torma, A.E., Desulfurization of coal by microbiological leaching. Final report, September 1, 1978-June 1, 1980, 6:16381 (NP—25377)
Torsaeter, O., *See* Hjelmeland, O., 6:16467
Trabalka, J.R., Russian experience, 6:17402 (CONF-791234—, pp 3-8)
Travis, C.C., *See* Post, W.M., 6:17395
Treves, S., Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4, pp 46-53)
Trimmer, D.A., *See* Durham, W.B., 6:17554
Trinity, P.M., *See* Reuveny, Z., 6:17474
Tripp, A.C., IPINV: a two-dimensional dipole-dipole resistivity modeling and inversion program. User's guide and documentation for Rev. 1, 6:17547 (DOE/ID/12079—25)
Tripp, L.J., *See* Ackerman, F.J., 6:16526
Trischan, G., *See* Golembiewski, M., 6:17362
Trotter, D.M. Jr., Design of selective surfaces for solar energy collection, 6:16711 (DOE/ET/20413—T1)
Troy, W.C., *See* Field, R.J., 6:17175
Tsai, C.C., Characteristics of a modified duoPIGatron negative ion source, 6:17583 (BNL—51304, pp 225-232)
Tserng, K.Y., Quantitation of labile keto bile acids in biological samples by sodium borodeuteride reduction prior to isolation and isotope ratio measurements of hydroxyl bile acids, 6:17481
Tsuzuki, T., *See* Tomita, Y., 6:17775
Tuohy, I.R., *See* Szkody, P., 6:17564
Tuozzolo, J., *See* Weng, W.T., 6:17265
Turner, L., Relaxation of toroidal discharges, 6:17783 (PPPL—1755, pp 94-97)
Turner, R.F., US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
Turner, W.C., Initial results of field reversed plasma gun experiment, 6:17845 (PPPL—1755, pp 16-19)
See Estes, C.B., 6:17053
See Viljoen, T.A., 6:16666
Tuszewski, M., *See* Armstrong, W.T., 6:17765
Tuttle, K.L., Method of regulating the amount of underfire air for combustion of wood fuels in spreader-stoker boilers, 6:17241
Twiss, R., Potential impacts of geothermal development on outdoor recreational use of the Salton Sea, 6:16745 (UCRL—13897(Rev.1))

U

Ubbels, J., Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
Ueno, K., *See* Yamanouchi, T., 6:17643
Ulerich, N.H., *See* Ciliberti, D.F., 6:16798
Ullmann, J.L., *See* Zanelli, C.I., 6:17702
Ulrickson, M., Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors, 6:17115
Umbarger, C.J., Soil monitoring instrumentation, 6:17403 (CONF-791234—, pp 41-45)
Umeda, T., *See* Shiroko, K., 6:17026
Ungers, L., *See* Owens, T., 6:16631
Urone, P.P., *See* Zanelli, C.I., 6:17702

V

Vaill, J.R., *See* Sargent, D.H., 6:16385
Vaillancourt, C., *See* Podesto, B., 6:16808
Van Bibber, K., *See* Doll, P., 6:17697
van Bommel, P.J., *See* Hopman, H.J., 6:17584
van Dyck, O.B., *See* Hagerman, D.C., 6:17257
See Jason, A.J., 6:17209
Van Harlingen, D.J., *See* Koch, R.H., 6:17217
Van Horn, A.J., Review of new source performance standards for coal-fired utility boilers, phase three report, sensitivity studies for the selection of a revised standard. Final report, 6:16797 (PB—80-213036)
Van Loon, L.S., *See* Harrison, W., 6:17433
Van Luik, A., *See* Harrison, W., 6:17433
Van Ness, J.E., *See* Brasch, F.M. Jr., 6:16811
Van Santen, E., *See* Schoeller, D.A., 6:17495

Van Voris, P., Functional complexity and ecosystem stability, 6:17398
van Wunnik, J., *See* Los, J., 6:17569
Vander Velde, J.C., Review of proton decay experiments, 6:17635 (SLAC—239, pp 457-474)
Vandergrift, T., *See* Gardner, J.F., 6:16446
Vanek, M.A., *See* Welsh, L.B., 6:16952
Vanier, P.E., Study of gap states in a-Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells, 6:16637 (BNL—29160)
Varnado, S.G., Geothermal drilling and completion technology development program plan, 6:16758 (SAND—81-0380)
See Huff, C.F., 6:16754
Vartsky, D., Method and an apparatus for non-invasively determining the quantity of an element in a body organ, 6:17322
See Ellis, K.J., 6:17526
Vaughan, D.S., *See* Adams, S.M., 6:16855
Velasquez, D.J., Tracheobronchial clearance studies in the guinea pig, 6:17513 (UR—3490-1981)
Veltman, M.J., Gauge theories of weak interactions, 6:17658 (SLAC—239, pp 1-27)
Vemuri, S., *See* Nelson, D.J., 6:16910
Verdeyen, J.T., *See* Miller, P.A., 6:17815
Verheij, C.P., *See* Ubbels, J., 6:17040
Verney, S., *See* Bacal, M., 6:17588
Vernon, J.M., *See* Grabowski, H.G., 6:16896
Viergutz, O.J., *See* Mattson, S., 6:16982
See McLean, R.F., 6:16983
Vilhjalmsson, H., *See* Strehl, P., 6:17284
Viljoen, T.A., Solar energy for charging fork truck batteries, 6:16666 (CONF-800483—(Vol.2), pp 839-846)
Villa, J.F., *See* Sullivan, S.M., 6:16686
Viola, V.E., *See* Mignerey, A.C., 6:17708
Viola, V.E. Jr., *See* Hilscher, D., 6:17719
Virginia, C., Nuclear waste disposal facility intrusion: an archeologist's perspective, 6:16561 (LA-UR—81-830)
Virk, P.S., *See* Reid, R.C., 6:16521, 6:16522
Vitek, V., Atomistic studies of grain boundaries with segregated impurities. Progress report, July 1, 1980-June 30, 1981, 6:17091 (DOE/ER/10429—T2)
Viyogi, Y.P., *See* Doll, P., 6:17697
Vlases, G.C., *See* Hoffman, A.L., 6:17860
Vo-Dinh, T., Recent developments in the analysis of air samples by luminescence techniques, 6:17350 (CONF-810346—1)
Vogtlin, G.E., *See* Kulke, B., 6:17283
Volkov, V.V., Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
Vonach, H., Measurement of the angle-integrated secondary neutron spectra from interaction of 14 MeV neutrons with medium and heavy nuclei, 6:17712 (DOE/NDC—21/L(Vol.1), pp 342-374)
See Wohlfarth, H., 6:17728
Vuletich, T., *See* Derenzo, S.E., 6:17491

W

Wachspress, E.L., Discrete-pressure equations in incompressible-flow problems, 6:17227 (KAPL—4139)
Waddell, B.V., *See* Hicks, H.R., 6:17771
Wagner, M.E., *See* Butz, T.R., 6:16535, 6:16536
Wagner, R.A., Preliminary investigation of the thermal and structural influence of crushed-salt backfill on repository disposal rooms, 6:16562 (ONWI—138)
Waibel, R.T., Multi-fuel low-NO/sub x/ burner development. Phase I. Final report, November 1978-March 1980, 6:17248 (PB—80-219587)
Wakeley, H., *See* Mattson, S., 6:16982
See McLean, R.F., 6:16983
Walch, S.P., *See* Dunning, T.H. Jr., 6:17616
Walker, F.J., Thermal conductivity and specific heat of a glass—epoxy composite at temperatures below 4 K, 6:17129
Wallace, A., *See* Romney, E.M., 6:16634
Wallace, P.M., *See* Neal, J.L., 6:17396
Wallerstein, P., *See* Sonderman, J., 6:17078
Walmer, D., *See* Sonderman, J., 6:17078
Walter, C.E, *See* Davis, D.D., 6:17073
Walter, K., *See* Reid, K., 6:16755
Walter, R.L., Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1), pp 259-275)
Walters, A., Evaluation of environmental issues on the use of peat as an energy source, 6:16417 (TR—80/031-001, pp 299-311)
Walters, C.T., *See* Bates, F.J., 6:17834, 6:17835
Walters, R.A., LA-UR—81-859, 6:17529 (CONF-810350—1)
Walton, D.R., *See* Eyster, J.M., 6:16419, 6:16420
Wambsganss, M.W., *See* Mulcahy, T.M., 6:16829
Wampler, F.B., *See* Shelton, R.N. Jr., 6:17608
Wanderer, P., Study of factors which affect training in ISABELLE R and D magnets, 6:17287 (BNL—29194)
See Thompson, P., 6:17295
Wang, C.B., *See* Feldberg, S.W., 6:17470
Wang, C.D., Deep-level transient spectroscopy system using a spectrum analyzer, 6:17335
Wang, F.T., *See* Campbell, J.H., 6:16418
Wang, J.M., *See* Ruth, R.D., 6:17254
Wang, L.L.C., Phenomenology of CP violation from the Kobayashi-Maskawa model, 6:17669 (BNL—29074)
Wang, R., Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)
Wanner, A., *See* Levy, S., 6:16871
Wapstra, A.H., Atomic masses for nuclides far from stability, 6:17716
Warburton, E.K., *See* Kozub, R.L., 6:17698
See Poletti, A.R., 6:17705
Ward, A.L., *See* Blackburn, L.D., 6:16843
Ward, D.S., *See* Yeh, G.T., 6:16579
Ward, M.A.V., Effects of microwaves on the performance of internal-combustion engines. Final technical report, September 30, 1979-January 31, 1981, 6:17056 (DOE/ET/13116—T13)
Ward, P.F., Smith, K.D., Vann, L.G. Jr., Analysis of financial incentives for biomass energy. Final report, 6:16651 (P—500-81-002)
Ward, S.H., *See* Chu, J.J., 6:16731
Waring, K., Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16492 (PB—80-210289)
Alaska OCS socioeconomic studies program. Technical report number 46. Volume 2. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16493 (PB—80-210297)
Warnock, R.L., *See* Johnson, P.W., 6:17680
Warpinski, N.R., Laboratory investigation on the effect of in situ stresses on hydraulic fracture containment, 6:16520 (SAND—80-2307C)
Warren, S., Radiation carcinogenesis. Comprehensive final report, 16 May 1979-31 December 1980, 6:17532 (DOE/EV/03017—43)
See Herzfeld, A., 6:17469
Warren, W.S., Experiments on selective excitation of multiple-quantum transitions in NMR spectroscopy, 6:17617
Wasan, D.T., Mechanism of oil bank formation, coalescence in porous media and emulsion stability. Annual report, June 1979-May 1980, 6:16480 (DOE/BC/10069—10)
Washburn, J., *See* Sadana, D.K., 6:17150
Washington, W.M., General circulation experiment with a coupled atmosphere, ocean and sea ice model, 6:17347
Wasielewski, M.R., *See* Overfield, R.E., 6:17186
Watanabe, T., *See* Tajima, T., 6:17662
Waterhouse, J.C., Alternative geographical display strategies for bivariate relationships, 6:17428 (CONF-810227—2)
Waterland, A.F., Analysis and development of large industrial steam systems, 6:16997 (CONF-800483—(Vol.2), pp 507-516)
Waterland, L.R., *See* Lim, K.J., 6:16801
See Lim, K.L., 6:17244
Watkins, J.B., *See* Schoeller, D.A., 6:17495
Watson, B.L., Graphic display of spatially distributed binary-state experimental data, 6:16861 (CONF-810235—1)
Watson, E.B., *See* Tomozawa, M., 6:17123
Watson, J.S., *See* Fisher, P.W., 6:16601
Watson, R.L., X-ray emission in heavy-ion collisions. Progress report, April 1, 1980-February 28, 1981, 6:17595 (DOE/ER/06036—1)
Watson, S., Incentives for technological innovation in air pollution reduction: an ETIP policy research series. Volume 5: an annotated bibliography of literature on market mechanisms and economic incentives for

environmental regulation. Final report, 6:17357 (PB—80-205610)
Watson, W., *See* Coultes, M.E., 6:16787
Watts, H.A., Recent developments in numerical ODES, 6:17898 (SAND—81-0013)
Watts, K.P., *See* Packer, S., 6:17512
Watts, R.L., *See* Smith, S.A., 6:16655
Weaver, W.L., *See* Spore, J.W., 6:16862
Webb, D., *See* Kitchell, J.F., 6:17399
Weber, S.L., *See* Mudge, L.K., 6:16654
Wechsler, D.J., Evaluation of hypocenter location techniques with applications to southern Utah: regional earthquake distributions and seismicity of geothermal areas, 6:16733 (DOE/ET/28392—32)
Wedge, D.E., Study of precipitate morphology by consideration of elastic strain energy, 6:17103 (LBL—10639)
Weidt, J.L., Field investigation of the performance of residential retrofit insulation, 6:16965 (NBS-TN—1131)
Weil, R., Fleet-Car Market PENetration Simulator: CPEN user's guide, 6:17064 (BNL—51286)
Weisberg, H.L., *See* Rodger, E.S., 6:17261
Weisenbloom, J., *See* Allinger, J.E., 6:17263
Weisheit, J.C., *See* Hatton, G.J., 6:17798
Welch, M., *See* Garling, W.S., 6:16770, 6:16776
Welch, M.J., *See* Kumar, B., 6:17494
Weller, P.J., *See* Ackerman, D.G., 6:17369
Weller, S.W., *See* Ramakrishnan, N.R., 6:17173
Welsh, L.B., Stability of Kocite electrocatalysts in phosphoric acid fuels cells. Final report, 6:16952 (EPRI-EM—1711)
Wendt, M., Look to the future: solar repowering for tomorrow's energy needs, 6:16676 (CONF-800483—(Vol.2), pp 820-830)
Weng, W.T., AGS fast kicker magnet system, 6:17265 (BNL—29187)
Wenninger, F., *See* Vonach, H., 6:17712
Wentink, T. Jr., *See* Wise, J.L., 6:16769
Werner, A.P., *See* Schneider, W.J., 6:17294
Wesely, M.L., Comments on "Bulk parameterization of air-sea exchanges of heat and water vapor including the molecular constraints at the interface" , 6:17558
Wesenberg, D.L., *See* Varnado, S.G., 6:16758
Wessol, D.E., Physics calculations for preliminary feasibility studies of fusion blanket testing in ETR, 6:17836 (EGG-PHYS—5392)
West, W., Valve requirements for the ICGG pipeline gas demonstration plant, 6:16362 (DOE/MC/14522—1, pp 11.1-11.8)
Westerman, R.E., Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Weston, K.J., *See* Binns, D.R., 6:16407
Weston, R.E. Jr., Comment on "IR lines broadened by chemical exchange", 6:17180
Westsik, J.H. Jr., Time and temperature dependence of the leaching of a simulated high-level waste glass, 6:16567 (PNL-SA—9054)
Wetmore, R.W., *See* Chen, M.M.L., 6:17155
Whaley, T.P., *See* Foh, S.E., 6:16594
Wham, R.M., *See* Salmon, R., 6:16384
Whealton, J.H., *See* Tsai, C.C., 6:17583
See Wooten, J.W., 6:17838
Wheeler, A., *See* Elrod, A., 6:16702
Wheelock, T.D., *See* Chuang, K.C., 6:16392
White, F.A., Public's rulemaking role starts during earliest conceptual stages, 6:16462
Whitfield, R.G., Application of a methodology for evaluation of intertechnology tradeoffs: an illustrative case study, 6:16899 (ANL/EES-TM—127)
Whitley, J.B., Testing of low-Z-coated limiters in tokamak fusion devices, 6:17831
See Mullendore, A.W., 6:17108
Whitney, K.T., *See* Alison, D.R., 6:16431
Wiedemann, E., Growth hormone and somatomedins, 6:17482
Wieland, R.M., *See* Lao, L.L., 6:17772
Wiemann, H., *See* Doll, P., 6:17697
Wigdor, M., Electric fields under power lines (supplement to 'an examination of electric fields under ehv (extra-high-voltage) overhead power transmission lines'). Final report, 6:16813 (PB—80-222474)
Wilcke, W.W., *See* Hilscher, D., 6:17719
See Mignerey, A.C., 6:17708
Wilder, J.A. Jr., Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
Willard, H.B., *See* Cverna, F.H., 6:17644
Willen, E., Magnetic properties of ISABELLE superconducting quadrupoles, 6:17288 (BNL—29195)
Willenberg, H.J., Tract: a small fusion reactor based on a compact torus plasma, 6:17879 (PPPL—1755, pp 233-236)
Willenborg, D.L., *See* Singleton, R.M., 6:17886
Williams, H.H., *See* Kim, J.E., 6:17645
Williams, L.R., *See* Ingersoll, D.T., 6:16846
Willis, J.B., *See* Milam, D., 6:17141
Wilmot, E.L., Report on a workshop on transportation-accident scenarios involving spent fuel, 6:16556 (SAND—80-2012)
Transportation accident scenarios for commercial spent fuel, 6:16557 (SAND—80-2124)
Wilms, D., *See* Strehl, P., 6:17284
Wilson, D.G., *See* Alexiades, V., 6:16880
Wilson, G.J., Development of models for the sodium version of the two-phase three-dimensional thermal hydraulics code THERMIT, 6:16868 (DOE/ET/37218—3)
Wilson, M.P., Assessment of treated vs untreated oil spills. Final report, 6:16499 (DOE/EV/24047—03)
Wilt, M., Electromagnetic (EM-69) survey of the McCoy geothermal prospect, Nevada, 6:16739 (LBL—12012)
Winegardner, M.K., *See* Kathren, R.L., 6:17314
Winn, D.R., Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647
Winter, J.L., *See* Augustine, F., 6:16794
Winters, W.I., Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Winzenried, R.W., *See* Hendrickson, R.R., 6:16757
Wirtenson, G.R., *See* Milam, D., 6:17141
Wise, D.L., *See* Levy, P.F., 6:16605
Wise, J.L., Wind energy resource atlas. Volume 10. Alaska region, 6:16769 (PNL—3195-WERA-10)
Wise, M.B., Three-body decays of the proton, 6:17664
Wisniewski, W., *See* Szkody, P., 6:17564
Witten, T.A. Jr., *See* Grest, G.S., 6:17752
Woelfle, R., *See* Qaim, S.M., 6:17704
Wohlfarth, H., Investigation of the ^{203} ^{205}Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
Wohn, F.K., *See* Talbert, W.L. Jr., 6:17715
Wolf, A.P., *See* Bloomer, W.D., 6:17514
Wolf, G., Highlights from PETRA experiments, 6:17304 (SLAC—239, pp 381-424)
Wolf, K.L., *See* Hilscher, D., 6:17719
See Mignerey, A.C., 6:17708
Wolff, S., *See* Morimoto, K., 6:17518
Wolsko, T.D., *See* Whitfield, R.G., 6:16899
Wolsky, A.M., *See* Shen, S., 6:16986
Wong, E.W., *See* Hamza, A.V., 6:16564
Wong, J., *See* Messmer, R.P., 6:17121
Wood, B.L., *See* Belew, W.W., 6:16628, 6:16687, 6:16707, 6:16726
Wood, J.L., Nutritional and protective properties of thiocystine, 6:17520
Wood, R.F., Control of melt-front velocity during pulsed laser annealing, 6:17146
Influence of carrier diffusion on melt-front penetration during pulsed-laser annealing, 6:17147
Macroscopic theory of pulsed-laser annealing. I. Thermal transport and melting, 6:17145
Woodall, D.M., *See* Smith, A.C. Jr., 6:17877
Woodcock, B.A., *See* Sargent, D.H., 6:16385
Woodhead, A.D., *See* Achey, P.M., 6:17522
Woodle, M.H., ISABELLE superconducting power distribution system, 6:17290 (BNL—29197)
Woodwell, G.M., *See* Houghton, R.A., 6:17400
Woolf, L.D., *See* MacKay, H.B., 6:17128
Wooten, J.W., Ion extraction and optics in three dimensions, 6:17838 (ORNL/TM—7691)
Worley, R.D., High Z (ash) analysis of TATB, 6:17338 (MHSMP—81-10)
Wortman, D., Overview of validation procedures for building energy-analysis simulation codes, 6:16978 (SERI/TP—721-1133)
Wozniak, G.J., *See* Schmitt, R.P., 6:17711
Wright, I.G., Materials for erosive valve applications, 6:16365 (DOE/MC/14522—1, pp 14.1-14.25)
Wright, J.H., *See* Yarbrough, D.W., 6:16966
Wuebbles, D.J., Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
Wuensch, B.J., High-temperature properties and processes in ceramics:

thermomigration. Annual report, January 1, 1980-December 31, 1980, 6:17119 (DOE/ER/02923—4)
Wunderle, J., *See* Dunbar, D., 6:17392

X

Xi-jun, S., Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727

Y

Yackle, T.R., Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)
Yager, J.A., International cooperation in nuclear energy, 6:16907
Yakura, S.J., Thermal background effects on the kink instability of a field-reversing ion layer, 6:17776 (PPPL—1755, pp 49-52)
Yamada, M., Design and fabrication of the S-1 spheromak device, 6:17865 (PPPL—1755, pp 171-175)
See Katsurai, M., 6:17874
Yamanouchi, T., Upper limits on phiphi production in 350-GeV/c proton-beryllium collisions, 6:17643
Yamauchi, R.K., *See* Brand, H.R., 6:17900
Yanase, Y., *See* Fassbender, A.G., 6:17037
Yang, T.M., Inelastic behavior of a dissimilar-metal-welded pipe transition joint: comparison of experimental measurements and analytical prediction, 6:16840 (GEFR-SP—148)
Yao, N.P., DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments, 6:17065 (CONF-800523—4)
Yarbrough, D.W., Reduction in the thermal resistance (R-value) of loose-fill insulation and fiberglass batts due to compression, 6:16966 (ORNL/Sub—7715/2)
Yasumura, S., *See* Ellis, K.J., 6:17526
Yee, R., FMVSS (Federal Motor Vehicle Safety Standard) 212/219/301 testing of electric vehicles - Electra Van 600, EVA Pacer. Final report, 6:17070 (PB—80-212020)
Yeh, G.T., AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)
FEMWASTE: a Finite-Element Model of Waste transport through porous saturated-unsaturated media, 6:16579 (ORNL—5601)
Moving boundary storm surge modelling with numerical methods, 6:17431 (ORNL—5611)
Yeh, T.T., *See* Mulcahy, T.M., 6:16829
Ying, D.H.S., Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow column), 6:16352 (DOE/ET/14801—6)
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow columns). Quarterly technical progress report, 1 April 1980-30 June 1980, 6:16353 (DOE/ET/14801—9)
Ying-xiang, G., *See* Xi-jun, S., 6:17727
Yoder, R.C., *See* Cummings, F.M., 6:17309, 6:17310
Yoshikawa, S., Toroidal plasma equilibrium with gravity, 6:17808
Utilization of electron coils for an advanced Tokamak and conjecture about the cause for current step (down), 6:17862 (PPPL—1755, pp 159-161)
Yoshimura, H., *See* Nogi, Y., 6:17858
Yost, T.M., *See* Gardner, J.F., 6:16446
Yotter, T., Gage chucking mechanism. Final report, 6:17204 (BDX—613-2560)
Youngblood, S.B., *See* Brink, D.F., 6:16694
Yu, A.D., *See* Orr, F.M. Jr., 6:16478
Yu, C., *See* Maddalone, R.F., 6:17352
Yu, W.S., *See* Powell, J.R., 6:17828
Yung, K.W., Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets, 6:17646
Yusas, M.R., Structural fabric and in-situ stress analyses of the Roosevelt Hot Springs KGRA, 6:16727 (DOE/ET/28392—31)

Z

Zabetakis, M.G., Test and evaluate the tri-gas low-Btu coal-gasification process. Final report, October 21, 1977-October 31, 1980, 6:16346 (DOE/ET/10254—88)
Zadworny, F., *See* Delaunay, M., 6:17586
Zahoor, A., *See* Kanninen, M.F., 6:16849
Zaikowski, A., Importance of resolution for helium detectors used in uranium exploration, 6:16537 (GJBX—38(81))
Zaitlin, M.P., Superconductivity in filamentary eutectic composites. Progress report, June 1, 1980-May 31, 1981, 6:17754 (DOE/ER/04938—T1)
Zakolski, R., Geophysical methods for coal seam variability detection in front of mining face. Report No. 1, state of the art report, 6:16427 (DOE/TIC—11444)
Zanelli, C.I., Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis, 6:17702 (DOE/NDC—21/L(Vol.1), pp 313-330)
Zanzi, I., *See* Ellis, K.J., 6:17526
Zatko, J.R., *See* Smelley, A.G., 6:17423
Zbasnik, J.P., Operation of the 8-T, 1-m-diameter test facility at Lawrence Livermore National Laboratory, 6:17887 (UCRL—85073)
Zebroski, E.L., Method and apparatus for reducing the power level in a nuclear reactor during temperature transient, 6:16853
Zee, A., Non-conservation of baryon number, 6:17672 (SLAC—239, pp 425-440)
Zein El-Din, H.M., *See* Coultes, M.E., 6:16787
Zeldin, A.N., Polymer-cement geothermal-well-completion materials. Final report, 6:16748 (BNL—51287)
Zheng, J.Q., Magnetization of compositionally modulated CuNi films, 6:17111
Zhi-zheng, Z., *See* Xi-jun, S., 6:17727
Ziegler, N.F., *See* Lord, R.S., 6:17272
Zielinski, R.E., Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1, 1980-December 31, 1980, 6:16509 (MLM-MU—81-53-0002)
Zimmerman, R., The administration of regulation: permit and licensing activities for water resource management in New York and New Jersey, 6:16917 (PB—80-223647)
Zimmerman, R.E., Evaluating and testing the coking properties of coal, 6:16394
Zlotin, Y.A., *See* Lindsey, K.E., 6:16809
Zollars, G.F., Hydrogen production. 1977-July 1980 (citations from the International Aerospace Abstracts data base). Report for 1977-July 1980, 6:16595 (PB—80-813553)
Zollner, W., *See* Kolbe, W.F., 6:17331
Zong-you, P., *See* Xi-jun, S., 6:17727

SUBJECT INDEX

The subject index is based on the use of subject descriptors selected from a controlled thesaurus of terms. Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR
Qualifier
Title, (supplementary information), citation number, (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

A

AC SYSTEMS
See also HVAC SYSTEMS
Electric Generators
Generalized model for electric distribution systems, 6:16804 (CONF-810433—1)

ACCELERATORS
See also BROOKHAVEN AGS
CERN SPS SYNCHROTRON
CYCLOTRONS
FERMILAB ACCELERATOR
ISOCHRONOUS CYCLOTRONS
LAMPF LINAC
LINEAR ACCELERATORS
NSLS
RAILGUN ACCELERATORS
STORAGE RINGS
UNILAC
Neutron Dosimetry
Practical neutron dosimetry at high energies, 6:17743 (LBL—11652)
Uses
New applications of particle accelerators in medicine, materials science, and industry, 6:17249 (LA-UR—81-818)

ACES
See QUARKS

ACETAMIDE
Electron Spin Resonance
INDO study of the anion radicals of acetic acid and acetamide. Nonplanarity and barriers to methyl group rotation, 6:17176
Molecular Structure
INDO study of the anion radicals of acetic acid and acetamide. Nonplanarity and barriers to methyl group rotation, 6:17176

ACETIC ACID
Biosynthesis
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)
Electron Spin Resonance
INDO study of the anion radicals of acetic acid and acetamide. Nonplanarity and barriers to methyl group rotation, 6:17176
Molecular Structure
INDO study of the anion radicals of acetic acid and acetamide. Nonplanarity and barriers to methyl group rotation, 6:17176

ACETONE
Biosynthesis
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)

ACETYLACETONE
Dichroism
Polarized x-ray absorption and double refraction in vanadyl bisacetylacetonate, 6:17174

ACID ELECTROLYTE FUEL CELLS
Cathodes
Stability of acid-fuel-cell cathode materials. Work period: January 1, 1978-December 31, 1979, 6:16950 (EPRI-EM—1664)
Electrocatalysts
Stability of Kocite electrocatalysts in phosphoric acid fuels cells. Final report, 6:16952 (EPRI-EM—1711)

ACID MINE DRAINAGE
Bibliographies
Coal and the environment abstract series: mine drainage bibliography 1929-1980. Final report, 6:16416 (PB—80-221062)

ACID RAIN
Biological Effects
Considerations of an air-quality standard to protect terrestrial vegetation from acidic precipitation, 6:17527 (BNL—29097)

ACIDS (ORGANIC)
See ORGANIC ACIDS

ACROLEIC ACID
See ACRYLIC ACID

ACRYLIC ACID
Biosynthesis
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)

ACTIN
Enzyme Inhibitors
Deoxyribonuclease I in mammalian tissues (Rats), 6:17472

ADENOSINE TRIPHOSPHATE
See ATP

ADHESIVES
Application of structure-property relationships to develop seven segmented polyurethane adhesives, 6:17133 (UCRL—84039)
Curing
Low-temperature curing of a nitrile-epoxy adhesive. Final report, 6:17136 (BDX—613-2553)

ADRENAL GLANDS
Radioisotope Scanning
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)

AEROSOL GENERATORS
Equations
Similarity theory for aerosol beams, 6:17346 (UR—3490-1979)
AEROSOL MONITORING
Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650)
Bibliographies
Air quality monitoring. 1977-1978 (citations from the NTIS data base). Report for 1977-78, 6:17374 (PB—80-813462)
Air quality monitoring. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980, 6:17375 (PB—80-813470)
AEROSOLS
See also RADIOACTIVE AEROSOLS
Aerosol Monitoring
Recent developments in the analysis of air samples by luminescence techniques, 6:17350 (CONF-810346—1)
Diagnostic Uses
Evaluation of the physical properties of monodisperse and heterodisperse aerosols used in the assessment of bronchial function, 6:17503 (UR—3490-1977)
Environmental Transport
Drainage flow over complex terrain, 6:17353 (LA-UR—80-3052)
Filtration
Determination of protection factors for tandem HEPA filters, 6:17354 (LA-UR—81-729)
Lung Clearance
Tracheobronchial clearance studies in the guinea pig, 6:17513 (UR—3490-1981)
Photoacoustic Spectroscopy
Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650)
Physical Properties
Evaluation of the physical properties of monodisperse and heterodisperse aerosols used in the assessment of bronchial function, 6:17503 (UR—3490-1977)
Removal
Large-scale tests of aqueous scrubber systems for LMFBR vented containment, 6:16872 (HEDL-SA—2121-FP)
AFRICA
See also SUDAN
Lakes
Paleochemistry of Plio-Pleistocene Lake Turkana, Kenya, 6:17546
AFTERBURNERS
Efficiency
Preliminary environmental assessment of afterburner combustion systems. Final report, March 1977-June 1980, 6:17245 (PB—80-215734)
Field Tests
Preliminary environmental assessment of afterburner combustion systems. Final report, March 1977-June 1980, 6:17245 (PB—80-215734)
AGRICULTURE
See also DAIRY INDUSTRY
FARMS
Economics
Economic analysis of wind-powered crop drying. Final report, 6:16776 (DOE/SEA—1109-20401/81/2)
Feasibility Studies
Economic analysis of wind-powered crop drying. Final report, 6:16776 (DOE/SEA—1109-20401/81/2)
AI AQUEOUS CARBONATE PROCESS
Aqueous carbonate process test requirements document. Final report, 6:16407 (EPRI-CS—1738)
AIR
See also EARTH ATMOSPHERE
Heat Transfer
Comments on "Bulk parameterization of air-sea exchanges of heat and water vapor including the molecular constraints at the interface" , 6:17558
Liquefaction
Energy and materials flows in the production of liquid and gaseous oxygen, 6:16986 (ANL/CNSV—15)
Separation Processes
Energy and materials flows in the production of liquid and gaseous oxygen, 6:16986 (ANL/CNSV—15)
AIR CLEANING SYSTEMS
Performance Testing
Large-scale tests of aqueous scrubber systems for LMFBR vented containment, 6:16872 (HEDL-SA—2121-FP)
AIR POLLUTION
See also INDOOR AIR POLLUTION
Atmospheric Chemistry
Fundamental spectroscopic studies of some atmospheric pollutants, 6:17343 (CONF-8005149—1)
Data Acquisition
The RAPS (regional air pollution study) helicopter air pollution measurement program, St. Louis, Missouri, 1974-76. Final report, 6:17361 (PB—80-213119)
Data Compilation
Compilation of environmental assessment data, February 1978-March 1979. Volume I. Studies 1-7. Final report, February 1978-March 1979, 6:17363 (PB—80-219546)
Compilation of environmental assessment data, February 1978-March 1979. Volume II. Studies 8 and 9. Final report, February 1978-March 1979, 6:17364 (PB—80-219553)
Compilation of environmental assessment data, February 1978-March 1979. Volume III. Studies 10-14. Final report, February 1978-March 1979, 6:17365 (PB—80-219561)
National emissions report, 1977: national emissions data system of the aerometric and emissions reporting system. Annual report, 6:17372 (PB—80-222532)
Environmental Effects
Effects of air emissions on wildlife resources. Air pollution and acid rain report No. 1, 6:17371 (PB—80-221708)
Environmental Exposure Pathway
Pathways of pollutants in the atmosphere, 6:17379
Environmental Impacts
Health impacts, emissions, and emission factors for noncriteria pollutants subject to de minimis guidelines and emitted from stationary conventional combustion processes, 6:17369 (PB—80-221237)
Environmental Transport
Pathways of pollutants in the atmosphere, 6:17379
Gas Analysis
Measurement of volatile organic compounds. Guideline series, 6:17370 (PB—80-221674)
Health Hazards
Health impacts, emissions, and emission factors for noncriteria pollutants subject to de minimis guidelines and emitted from stationary conventional combustion processes, 6:17369 (PB—80-221237)
Information Systems
Environmental assessment data systems user guide: Fine Particle Emissions Information System. Final report, September 1978-September 1979, 6:17905 (PB—80-222433)
Meetings
Pathways of pollutants in the atmosphere, 6:17379
Monitoring
Air quality monitoring. 1977-1978 (citations from the NTIS data base). Report for 1977-78, 6:17374 (PB—80-813462)
Air quality monitoring. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980, 6:17375 (PB—80-813470)
Seasonal variations in light scattering in the New York region and their relation to sources, 6:17349 (BNL—29271)
Mutagenesis
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
Pollution Regulations
Impact of proposed and alternative 'de minimis' levels for criteria pollutants, 6:17393 (PB—80-221229)
Pollution Sources
National emissions report, 1977: national emissions data system of the aerometric and emissions reporting system. Annual report, 6:17372 (PB—80-222532)
Surveys
Compilation of environmental assessment data, February 1978-March 1979. Volume I. Studies 1-7. Final report, February 1978-March 1979, 6:17363 (PB—80-219546)
Compilation of environmental assessment data, February 1978-March 1979. Volume II. Studies 8 and 9. Final report, February 1978-March 1979, 6:17364 (PB—80-219553)

Compilation of environmental assessment data, February 1978-March 1979. Volume III. Studies 10-14. Final report, February 1978-March 1979, 6:17365 (PB—80-219561)

Visibility

Protecting visibility: an EPA report to Congress. Final report, 6:17366 (PB—80-220320)

AIR POLLUTION ABATEMENT

Bibliographies

Incentives for technological innovation in air pollution reduction: an ETIP policy research series. Volume 5: an annotated bibliography of literature on market mechanisms and economic incentives for environmental regulation. Final report, 6:17357 (PB—80-205610)

Financial Incentives

Incentives for technological innovation in air pollution reduction: an ETIP policy research series. Volume 5: an annotated bibliography of literature on market mechanisms and economic incentives for environmental regulation. Final report, 6:17357 (PB—80-205610)

Technology Utilization

Incentives for technological innovation in air pollution reduction: an ETIP policy research series. Volume 3: opportunities for innovation: administration of sections 111(j) and 113(d) (4) of the Clean Air Act and industry's development of innovative control technology. Final report, 6:17387 (PB—80-205024)

AIR POLLUTION CONTROL

Cost

New source performance standards for industrial boilers. Volume 1. Analysis of fuel use implications, 6:17386 (ANL/EES-TM—103)

AIR POLLUTION MONITORS

Bibliographies

Air quality monitoring. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980, 6:17375 (PB—80-813470)

AIR QUALITY

Bibliographies

Air quality monitoring. 1977-1978 (citations from the NTIS data base). Report for 1977-78, 6:17374 (PB—80-813462)

Biological Indicators

Effects of air emissions on wildlife resources. Air pollution and acid rain report No. 1, 6:17371 (PB—80-221708)

Computerized Simulation

CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Model-simulation, 6:17367 (PB—80-220833)

CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Interim report, 6:17368 (PB—80-220841)

Monitoring

Air quality monitoring. 1977-1978 (citations from the NTIS data base). Report for 1977-78, 6:17374 (PB—80-813462)

AIRFOILS

Transonic Flow

Unsteady transonic flow past airfoils in rigid-body motion, 6:17226 (DOE/ER—03077-170)

Unsteady Flow

Unsteady transonic flow past airfoils in rigid-body motion, 6:17226 (DOE/ER—03077-170)

AIRPORTS

Aerosol Monitoring

Health hazard evaluation determination report: HE 79-124-682: Orlando International Airport, Orlando, Florida, 6:17373 (PB—80-223514)

Air Pollution

Health hazard evaluation determination report: HE 79-124-682: Orlando International Airport, Orlando, Florida, 6:17373 (PB—80-223514)

ALABAMA

Water Resources

Water resources appraisals for hydroelectric licensing: Tombigbee-Warrior River Basin, Alabama and Mississippi. Planning status report, 6:16625 (FERC—0078)

ALAP

See RADIATION PROTECTION

ALARA

See RADIATION PROTECTION

ALASKA

Demography

Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report, 6:16497 (PB—80-222482)

Earthquakes

Rupture zones of great earthquakes in the Alaska-Aleutian arc, 1784 to 1980, 6:17551

Peat

Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)

Wind Power

Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)

Wind energy resource atlas. Volume 10. Alaska region, 6:16769 (PNL—3195-WERA-10)

ALBANIA

Research Programs

East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)

ALBEDO-NEUTRON DOSEMETERS

Energy Dependence

Neutron response study, 6:17308 (PNL—3536)

Evaluation

Phantom position dependence, 6:17312 (PNL—3536)

Spatial Dependence

Phantom position dependence, 6:17312 (PNL—3536)

ALCOHOL FUELS

See also ETHANOL FUELS
METHANOL FUELS

Energy Balance

Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)

Legislation

Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)

Research Programs

Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)

ALGORITHMS

Computing percentiles of large data sets, 6:17897 (LA-UR—81-1024)

Influence of computer architectures on numerical algorithms, 6:17901 (UCRL—85679)

ALKALI METALS

See also CESIUM
LITHIUM
POTASSIUM
RUBIDIUM
SODIUM

Plasmons

Determinations of lattice and electronic structures of solids by electron scattering. Progress report, 6:17750 (DOE/ER/10440—2)

Work Functions

Properties of alkali metals adsorbed onto metal surfaces, 6:17579 (BNL—51304)

ALKENES

See also HEXENES

Synthesis

Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)

ALKYLATION

Catalysts

Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)

ALLOCATIONS

Evaluation

Motor gasoline allocation; adjustment and downward certification, 6:16922 (DOE/RG/10333—T1)

ALLOY 800

See INCOLOY 800

ALLOY-HD-556

Creep

Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

ALLOY-HD-8077
See NICKEL BASE ALLOYS

ALLOY-HK-40
Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

ALLOY-HT-9
Corrosion
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
Fracture Properties
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)

ALLOY-MA-754
See NICKEL BASE ALLOYS

ALLOY-MM-0011
See IRON BASE ALLOYS

ALLOYS
See also BRAZING ALLOYS
Electronic Structure
Study of local atomic and electronic structure in glassy metallic alloys. Progress report, December 1, 1979-November 1, 1980, 6:17121 (DOE/ER/10382—2)

ALLOY-WAZ-16
See NICKEL BASE ALLOYS

ALPHA DECAY RADIOISOTOPES
Chemical Preparation
Development and therapeutic application of internally emitting radiopharmaceuticals, 6:17197 (DOE/EV/04115—4)
Research Programs
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)

ALPHA REACTIONS
Elastic Scattering
Nuclear structure approach to the calculation of the imaginary alpha-nucleus optical potential (31 and 100 MeV), 6:17701 (DOE/ER/10405—2)

ALTERNATE FUELS
See FUEL SUBSTITUTION

ALUMINA
See ALUMINIUM OXIDES

ALUMINATES
Fabrication
Advanced fuel-cell development. Progress report, January-March 1980 (β-$LiAlO_2$), 6:16946 (ANL—80-67)
Mechanical Properties
Advanced fuel-cell development. Progress report, January-March 1980 (β-$LiAlO_2$), 6:16946 (ANL—80-67)

ALUMINIUM
Gas Tungsten-Arc Welding
Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)
Joining
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Recycling
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)
Reflective Coatings
Improved aluminum coatings for the ultraviolet, 6:17102 (LA-UR—81-747)
X-Ray Fluorescence Analysis
Determinations of lattice and electronic structures of solids by electron scattering. Progress report, 6:17750 (DOE/ER/10440—2)

ALUMINIUM 27 TARGET
Neutron Reactions
Helium generation cross sections for fast neutrons, 6:17707 (DOE/NDC—21/L(Vol.1))
Pion Minus Reactions
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
Pion Plus Reactions
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
Proton Reactions
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646

ALUMINIUM 28
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322

ALUMINIUM ARSENIDES
Crystal Growth
Growth of extremely uniform layers by rotating substrate holder with molecular beam epitaxy for applications to electro-optic and microwave devices, 6:17148

ALUMINIUM OXIDES
Neutron Reactions
Neutronic calculations for the conceptual design of an in-reactor solid breeder experiment, TRIO-01, 6:17839 (ORNL/TM—7758)
Optical Properties
High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers, 6:17890

ALUMINIUM SILICATES
Density
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Hot Pressing
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Leaching
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Porosity
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)

ALUMINIUM-AIR BATTERIES
Capitalized Cost
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
Energy Consumption
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)

AMBIENT TEMPERATURE
Correlations
Oxygen isotope ratios in trees reflect mean annual temperature and humidity, 6:17517

AMERICIUM 241
Radiation Monitoring
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
Radioecological Concentration
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)

AMES TEST
See MUTAGEN SCREENING

AMINES
Radiosensitivity Effects
Nutritional and protective properties of thiocystine, 6:17520

AMINOGLYCIDES
See AMINES

AMINOTRANSFERASES
Enzyme Activity
Chronotypic induction of tyrosine aminotransferase by α-methyl-p-tyrosine (Rat liver), 6:17471
Tissue enzyme changes in parabiotic rats with subcutaneous lymphoma, 6:17469 (DOE/EV/03017—T1)
AMMONIA
Removal
Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes, 6:16375 (FE—2806-16)
Ultraviolet Spectra
Mercury—ammonia system at high mercury densities, 6:17222
AMMUNITION
Manufacturers
Pollution caused by ammunition manufacturing. 1964-July 1980 (citations from the NTIS data base). Report for 1964-July 1980, 6:17376 (PB—80-814478)
AMNION CELLS
See EMBRYONIC CELLS
AMYL ALCOHOLS
See PENTANOLS
ANAEROBIC DIGESTION
Economic Analysis
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Reviews
Biomass energy enhancement, 6:16649
Solar Process Heat
Applications of shallow solar ponds in wastewater treatment, 6:16720 (UCRL—15329)
Technology Assessment
Biomass energy enhancement, 6:16649
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Temperature Dependence
Full scale field demonstration of unheated anaerobic contact stabilization. Quarterly project status report, July 1980-September 1980, 6:16603 (DOE/CS/24310—2)
ANDCO-TORRAX SLAGGING PYROLYSIS SYSTEM
See SLAGGING PYROLYSIS PROCESS
ANESTHETICS
Biological Effects
Effects of local anesthetics on cholinergic agonist binding affinity of central nervous system α-bungarotoxin receptors, 6:17478
ANGIOGRAPHY
See BIOMEDICAL RADIOGRAPHY
ANHARMONIC CRYSTALS
Electron Gas
Self-consistent phonon approximations for the solid phase of a one-component plasma, 6:17751
Equations of State
Self-consistent phonon approximations for the solid phase of a one-component plasma, 6:17751
Phonons
Self-consistent phonon approximations for the solid phase of a one-component plasma, 6:17751
ANIMAL CELLS
See also EMBRYONIC CELLS
RESPIRATORY TRACT CELLS
THYROID CELLS
RNA
LA-UR—81-859 (CHO cells), 6:17529 (CONF-810350—1)
ANNEALING
Glow Curve
Extremity dosimeter studies, 6:17314 (PNL—3536)
ANNUAL ENERGY STORAGE
Longterm solar heat storage (abstract), 6:16725 (CONF-810509—1)
ANNULAR FUEL ELEMENTS
Hydraulics
Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers (PWR; BWR), 6:16829 (GEAP—24310)
ANTIMONY 133
Beta-Minus Decay
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region, 6:17717
ANTIMONY ISOTOPES
Energy Levels
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region (Petrovich-McManus-Madsen effective interaction), 6:17717
ANTINEOPLASTIC DRUGS
Purification
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
ANTINEUTRINO-NUCLEON INTERACTIONS
Inclusive Interactions
Some results from the charm neutrino experiment at the CERN SPS, 6:17637 (SLAC—239)
Particle Production
Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647
Total Cross Sections
Recent results from the CFRR neutrino experiment at Fermilab, 6:17636 (SLAC—239)
ANTINEUTRINOS
Deuteron Reactions
Neutrino instability, 6:17634 (SLAC—239)
ANTISERUM
See IMMUNE SERUMS
ANTRIM SHALES
See BLACK SHALES
APARTMENT BUILDINGS
Energy Efficiency
Optimum utilization of site energy sources for all-season thermal comfort in new residential construction for single-family attached (rowhouse/townhouse) designs, 6:16698 (DOE/R5/10215—1)
Solar Space Heating
Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico, 6:16708 (SOLAR/1008—80/50)
Solar Water Heating
Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico, 6:16708 (SOLAR/1008—80/50)
Thermal Comfort
Optimum utilization of site energy sources for all-season thermal comfort in new residential construction for single-family attached (rowhouse/townhouse) designs, 6:16698 (DOE/R5/10215—1)
APPARATUS
See EQUIPMENT
APPLIANCES
See also GAS APPLIANCES
Energy Efficiency
Energy efficiency studies: building energy performance standards for residential buildings, 6:16905 (LBL—11972)
APPROPRIATE TECHNOLOGY
See also TECHNOLOGY UTILIZATION
Research Programs
Summary of projects, small scale appropriate energy technology. Region IX program, 1979, 6:16885 (DOE/SF/01963—T3)
Summary of projects: small-scale Appropriate-Energy Technology Grants Program, 6:16903 (DOE/SF/01963—T1)
AQUATIC ECOSYSTEMS
Functional Models
Guidance for use of experimental systems to evaluate effects of stress in marine ecosystems, 6:17425 (ORNL/TM—7644)
Simulation
Guidance for use of experimental systems to evaluate effects of stress in marine ecosystems, 6:17425 (ORNL/TM—7644)
AQUIFERS
Contamination
AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)

ARC WELDING
See also GAS TUNGSTEN-ARC WELDING
Heat Transfer
Basic study of heat flow in fusion welding. Progress report, March 1, 1980-February 28, 1981, 6:17088 (DOE/ER/04799—2)
ARCHAEOLOGICAL SPECIMENS
Activation Analysis
Tell el Yahudiyeh Ware: a re-evaluation, 6:17156 (BNL—29258)
ARCTIC REGIONS
Natural Gas Deposits
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
Petroleum Deposits
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
ARGILLITE
Radionuclide Migration
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
Sorptive Properties
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
ARGINASE
Enzyme Activity
Tissue enzyme changes in parabiotic rats with subcutaneous lymphoma, 6:17469 (DOE/EV/03017—T1)
ARGON
Atom-Molecule Collisions
Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer, 6:17611
De-Excitation
Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer, 6:17611
Diffusion
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
Electron-Atom Collisions
[Interaction of slow electrons with high-pressure gases (quasi-liquids): synthesis of our knowledge on slow electron-molecule interactions. Progress report for year ending May 31, 1981, 6:17601 (DOE/EV/04703—T1)
Ion-Atom Collisions
Collisional decomposition of UF_6^-, 6:17619
ARGON 40 REACTIONS
Deep Inelastic Heavy Ion Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
Fusion Reactions
Nuclear research with heavy ions. Annual progress report. January 1, 1980-December 31, 1980, 6:17724 (DOE/ER/13246—20)
AROMATICS
See also BENZENE
CONDENSED AROMATICS
POLYCYCLIC AROMATIC HYDROCARBONS
QUINONES
STYRENE
TETRALIN
TOLUENE
Fluorescence
High pressure study of viscosity effects on the luminescence of tetracyanobenzene EDA complexes, 6:17179
Solvent Properties
Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C, 6:17183
ARSENIC
Ecological Concentration
Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583
ARSENIC OXIDES
Toxicity
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
ARYL RADICALS
Chemical Reactions
Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C, 6:17183
ASBESTOS
Carcinogenesis
Radiation carcinogenesis. Comprehensive final report, 16 May 1979-31 December 1980, 6:17532 (DOE/EV/03017—43)
Separation Processes
Quantitative separation of asbestos in environmental samples. Final report, August 1978-August 1979, 6:17344 (PB—80-219413)
ASHES
See also FLY ASH
Abundance
High Z (ash) analysis of TATB, 6:17338 (MHSMP—81-10)
Chemical Analysis
Evaluating and testing the coking properties of coal (Book; 44 references), 6:16394
Sorptive Properties
Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))
ASPHALTS
Testing
Laboratory evaluation of selected tar sand asphalts, 6:16529 (DOE/LC/10049—T1)
ASSIGNMENTS
See ALLOCATIONS
ASTATINE 202
Decay
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)
ASTATINE 211
Acylation
Development and therapeutic application of internally emitting radiopharmaceuticals, 6:17197 (DOE/EV/04115—4)
Aryl Radicals
Development and therapeutic application of internally emitting radiopharmaceuticals, 6:17197 (DOE/EV/04115—4)
ASTEROIDS
Collisions
Collisions of asteroids on neutron stars as a cause of cosmic gamma ray bursts, 6:17563
ASTROCYTOMAS
See NEOPLASMS
ATMOSPHERIC PRECIPITATIONS
Isotope Ratio
Oxygen isotope ratios in trees reflect mean annual temperature and humidity, 6:17517
ATOM-ATOM COLLISIONS
Charge Exchange
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
ATOMIC BEAMS
Beam Production
Cesium supersonic jet for D^- production by double electron capture, 6:17588 (BNL—51304)
ATOMIC EXPLOSIONS
See NUCLEAR EXPLOSIONS
ATOMS
See also MUONIC ATOMS
Hyperfine Structure
Effects of hyperfine structure on coherent excitation, 6:17602
ATP
(Adenosine triphosphate.)
Aquatic Ecosystems
Adenosine triphosphate (ATP) in the marine environment: a bibliography, 6:17430 (LBL—12431)

AUGER MINING
Mining Equipment
Feasibility of high recovery highwall mining equipment. Final report, 6:16425 (DOE/ET/11268—9)
Production
Feasibility of high recovery highwall mining equipment. Final report, 6:16425 (DOE/ET/11268—9)
Productivity
Impact analysis of OSM regulations on highwall mining systems. Final report, 6:16460 (DOE/ET/11268—6)
Regulations
Feasibility of high recovery highwall mining equipment. Final report, 6:16425 (DOE/ET/11268—9)
Impact analysis of OSM regulations on highwall mining systems. Final report, 6:16460 (DOE/ET/11268—6)

AUTOMOBILE EXHAUST REACTORS
See AFTERBURNERS

AUTOMOBILES
Catalytic Converters
Analysis of options to limit air quality degradation due to misuse of leaded gasoline in cars equipped with catalytic converters. Paper (final), 6:17390 (PB—80-212780)
Papers related to gasoline supply, misfueling and environmental air quality for the summer of 1979. Paper (final), 6:17391 (PB—80-212798)
Design
Design for fuel economy: the General Motors X cars (Book), 6:17074
Diesel Engines
Assessment of diesel particulate control: particle size measurements. Final report, November 1978-November 1979, 6:17062 (PB—80-224256)
Assessment of environmental impacts of light duty vehicle dieselization. Final report, May 1978-March 1979, 6:17061 (PB—80-220759)
Exhaust Gases
Emission laboratory correlation study between EPA and the Japan Automobile Manufacturers Association, Inc. Technical report, 6:17075 (PB—80-209877)
Lighting Systems
Cost analysis for upgraded passenger car rear signal lighting requirements. Final report, December 1979-June 1980, 6:16983 (PB—80-219728)
Performance Testing
Emission laboratory correlation study between EPA and the Japan Automobile Manufacturers Association, Inc. Technical report, 6:17075 (PB—80-209877)
Pollution Control Equipment
Durability demonstration of systems for control of sulfuric acid. Final report, November 1976-September 1979, 6:17360 (PB—80-212129)

AUTOMOTIVE FUELS
See also GASOLINE
Combustion
Effects of microwaves on the performance of internal-combustion engines. Final technical report, September 30, 1979-January 31, 1981, 6:17056 (DOE/ET/13116—T13)

AUTOMOTIVE INDUSTRY
Energy Management
Energy Responsibility Accounting: an energy-conservation tool for industrial facilities, 6:17021 (CONF-800483—(Vol.2))
Test Facilities
Emission laboratory correlation study between EPA and the Japan Automobile Manufacturers Association, Inc. Technical report, 6:17075 (PB—80-209877)

B

B-1235 RESONANCES
Hadronic Particle Decay
CP violation in B-meson decays, 6:17673

BALLOONING INSTABILITY
Variational Methods
High-n ballooning modes in highly elongated tokamaks, 6:17818

BARBITURATES
See also PHENOBARBITAL
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

BARBITURIC ACID
See BARBITURATES

BARIUM
Decay
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)

BARIUM ISOTOPES
Hyperfine Structure
Sizes and shapes of short-lived nuclei via laser spectroscopy. Progress report, May 1, 1980-January 31, 1981, 6:17597 (DOE/ER/10496—2)

BARIUM SULFATES
Solubility
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)

BARSTOW SOLAR PILOT PLANT
Heliostats
Collector subsystem for the 10 MW/sub e/ solar thermal central receiver pilot plant. Phase 1. Technical status report, Issue 5, 6:16677 (MCR—78-1325)
Overall plant design description for collector subsystem for the 10-MW/sub e/ solar-thermal central-receiver pilot plant. Phase 1, 6:16678 (MCR—79-1311)

BARYON NUMBER
Conservation Laws
Non-conservation of baryon number, 6:17672 (SLAC—239)
Review of proton decay experiments, 6:17635 (SLAC—239)
Invariance Principles
Three-body decays of the proton, 6:17664

BARYONS
See also NUCLEONS
Dynamical Groups
Pion-nucleon partial wave analysis and study of baryon structure. Progress report, June 1, 1979-May 31, 1981, 6:17655 (DOE/ER/10402—T1)
Sum Rules
Theoretical studies of high-energy phenomena: analysis of models of CP and T violation. Progress report, February 15, 1980-April 30, 1981, 6:17671 (DOE/ER/10587—1)

BASALT
Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980, 6:16568 (RHO-BWI—80-100-4Q)

BATTELLE COLUMBUS LABORATORY
Tornadoes
Calculation of particulate dispersion in a design-basis tornadic storm from the Battelle Memorial Institute, Columbus, Ohio, 6:17383 (DP—1583)

BATTERIES (ELECTRIC)
See ELECTRIC BATTERIES

BATTERY CHARGERS
See also SOLAR BATTERY CHARGERS
Design
Electrochemically controlled charging circuit for storage batteries (Patent), 6:16883

BATTERY CHARGING
Optimization
Electric and hybrid vehicles charge efficiency tests of ESB EV-106 lead-acid batteries, 6:17068 (DOE/CS/54209—T1)

BCC LATTICES
Fatigue
Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II, 6:17095 (DOE/ER/10433—2)

BEAGLES
Radionuclide Kinetics
In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs (Thesis), 6:17535 (UR—3490-1883)

BEAM BENDING MAGNETS
Beam Dynamics
Edge focusing, 6:17252 (BNL—29211)
Magnetic Fields
Inhomogeneities in magnetic field due to variations of lamination gap heights, 6:17253 (BNL—29212)
Mechanical Tests
Mechanical properties of ISABELLE superconducting coils, 6:17295 (BNL—29236)
Study of factors which affect training in ISABELLE R and D magnets, 6:17287 (BNL—29194)
Performance Testing
Tests of a 3 meter curved superconducting beam transport dipole magnet, 6:17263 (BNL—29174)
Superconducting Magnets
Tests of a 3 meter curved superconducting beam transport dipole magnet, 6:17263 (BNL—29174)
BEAM BUNCHING
Beam Dynamics
Vertical fast blow-up in a single bunch, 6:17254 (BNL—29215)
Synchrotron Oscillations
Vertical fast blow-up in a single bunch, 6:17254 (BNL—29215)
BEAM FOCUSING MAGNETS
Functional Models
Magnetic properties of ISABELLE superconducting quadrupoles, 6:17288 (BNL—29195)
Magnetic Properties
Magnetic properties of ISABELLE superconducting quadrupoles, 6:17288 (BNL—29195)
BEAM MONITORS
Performance
LAMPF hardware beam transmission monitor systems, 6:17277 (LA-UR—81-731)
BELGIUM
Energy Demand
Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912
BENZENE
Alkylation
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
NMR Spectra
Experiments on selective excitation of multiple-quantum transitions in NMR spectroscopy, 6:17617
Photolysis
Multiphoton dissociation spectroscopy and photochemistry. Progress report, July 15, 1980-March 15, 1981, 6:17187 (DOE/ER/10660—1)
Synthesis
Peat gasification: Rockwell International process, 6:16611 (TR—80/031-001)
BENZOPYRENE
Metabolism
Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding, 6:17473
BERYLLIUM 9 REACTIONS
Compound-Nucleus Reactions
Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
Nuclear structure of high-spin states in ^{46}Ti and ^{46}V, 6:17705
BERYLLIUM 9 TARGET
Deuteron Reactions
Characterization of the Be(d,n) neutron field by passive dosimetry techniques, 6:17690 (DOE/NDC—21/L(Vol.1))
Low energy neutron emission from Be(d,n) and Be(p,n) reactions (10 to 25 MeV), 6:17691 (DOE/NDC—21/L(Vol.1))
Lithium 7 Reactions
Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
Neutron Reactions
Cross sections for the reactions of $^{9}Be(n,t_1\gamma)$ and $^{12}C(n,n'\gamma)$ between 13.0 and 15.0 MeV, 6:17696 (DOE/NDC—21/L(Vol.1))
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Proton Reactions
Low energy neutron emission from Be(d,n) and Be(p,n) reactions (10 to 25 MeV), 6:17691 (DOE/NDC—21/L(Vol.1))
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Upper limits on phiphi production in 350-GeV/c proton-beryllium collisions, 6:17643
BETA DETECTION
Comparative Evaluations
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Limiting Values
Statistical and low dose response, 6:17315 (PNL—3536)
Sensitivity Analysis
Statistical and low dose response, 6:17315 (PNL—3536)
Statistics
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Statistical and low dose response, 6:17315 (PNL—3536)
BETA DOSIMETRY
Comparative Evaluations
Extremity dosimeter studies, 6:17314 (PNL—3536)
BETA II DEVICES
Magnetic Field Reversal
Reconnection conditions for flowing field-reversed plasma from a plasma gun, 6:17852 (PPPL—1755)
Plasma Diagnostics
Two-wavelength HeNe laser interferometer, 6:17801 (UCID—18988)
BETA SPECTRA
MeV Range 01-10
Beta and low energy photon response, 6:17310 (PNL—3536)
Thermoluminescent Dosimetry
Beta and low energy photon response, 6:17310 (PNL—3536)
BICYCLES
National Program Plans
Bicycle Promotion Plan, 6:16981 (DOE/IR/10999—1)
Program Management
Bicycle Promotion Plan, 6:16981 (DOE/IR/10999—1)
BI-GAS PROCESS
Valves
BI-GAS gasification process and valve requirements, 6:16364 (DOE/MC/14522—1)
BIKINI
Local Fallout
Regulatory analysis, 6:17421 (PNL—3700(Pt.5))
BILE ACIDS
Quantitative Chemical Analysis
Quantitation of labile keto bile acids in biological samples by sodium borodeuteride reduction prior to isolation and isotope ratio measurements of hydroxyl bile acids, 6:17481
BIOCONVERSION
See also ANAEROBIC DIGESTION
FERMENTATION
Financial Incentives
Analysis of financial incentives for biomass energy. Final report, 6:16651 (P—500-81-002)
BIOLOGICAL REGENERATION
Molecular Biology
Cellular proliferation and regeneration following tissue damage. Final report, 6:17502 (DOE/EV/02401—T1)
BIOLOGICAL REPAIR
Radioinduction
DNA repair in a short- and a long-lived rodent species, 6:17521
BIOMASS
(All growing organic matter such as plants, trees, grasses, and algae.)
See also MAIZE
PLANTS
SUGAR BEETS
TREES
WOOD
WOOD WASTES
Anaerobic Digestion
Energy from biomass and wastes: 1980 update, 6:16664
Liquid fuels production from biomass. Final report, 6:16605 (DOE/ET/20050—T4)

Combustion
Energy from biomass and wastes: 1980 update, 6:16664
Conversion
Biomass energy enhancement, 6:16649
Energy Source Development
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Fermentation
Energy from biomass and wastes: 1980 update, 6:16664
Liquid fuels production from biomass. Final report, 6:16605 (DOE/ET/20050—T4)
Financial Incentives
Analysis of financial incentives for biomass energy. Final report, 6:16651 (P—500-81-002)
Gasification
Energy from biomass and wastes: 1980 update, 6:16664
Liquefaction
Chemical Process Research and Development Program, 6:16615 (LBL—11650)
Energy from biomass and wastes: 1980 update, 6:16664
Resource Assessment
Biomass energy enhancement, 6:16649
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Reviews
Biomass energy enhancement, 6:16649

BIOMASS CONVERSION PLANTS
Energy from biomass and wastes: 1980 update, 6:16664
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939

BIOMASS PLANTATIONS
Energy Source Development
Petroleum plantations for fuel and materials, 6:16665
Meetings
Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)

BIOMEDICAL RADIOGRAPHY
Bibliographies
Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497
Diagnostic Uses
Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4)

BISMUTH 209 TARGET
Carbon 12 Reactions
Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727
Iron 56 Reactions
Charge and mass exchange in ^{56}Fe-induced reactions (465 MeV), 6:17708 (INIS-mf—6088)
Neutron Reactions
Measured and evaluated bismuth cross sections for fusion-fission hybrid reactors (1.2 to 4.5 MeV), 6:17726 (DOE/NDC—21/L(Vol.2))

BISMUTH COMPOUNDS
Dissociation Energy
Dissociation energies of molecules with very heavy atoms from mass spectrometry, 6:17622

BITUMENS
See also ASPHALTS
Recovery
Assessment of international tar sands recovery and upgrading processes, 6:16527 (UCRL—15323)
Refining
Assessment of international tar sands recovery and upgrading processes, 6:16527 (UCRL—15323)

BLACK COATINGS
Electrodeposition
Black chromium-molybdenum: a new stable solar absorber, 6:16721
Spectral Reflectance
Black chromium-molybdenum: a new stable solar absorber, 6:16721

BLACK SHALES
Chemical Analysis
Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1, 1980-December 31, 1980, 6:16509 (MLM-MU—81-53-0002)
Geochemistry
Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1, 1980-December 31, 1980, 6:16509 (MLM-MU—81-53-0002)
Mineralogy
Sample preparation of x-ray diffraction analysis and clay mineralogy of Devonian shale from the Appalachian basin, 6:16524 (DOE/METC—2287/112)
Sample Preparation
Sample preparation of x-ray diffraction analysis and clay mineralogy of Devonian shale from the Appalachian basin, 6:16524 (DOE/METC—2287/112)

BLOOD PLASMA
Radionuclide Kinetics
In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs (Thesis), 6:17535 (UR—3490-1883)

BLOOD SERUM
Copper
Serum copper and zinc levels in melanoma patients, 6:17493
Zinc
Serum copper and zinc levels in melanoma patients, 6:17493

BODY CENTERED CUBIC
See BCC LATTICES

BODY FLUIDS
See also MILK
URINE
Nuclear Magnetic Resonance
Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)

BODY TEMPERATURE
Daily Variations
Phenobarbital effects on weight gain and circadian cycling of food intake and body temperature, 6:17536

BOGS
See SWAMPS

BOILERS
Air Pollution Abatement
Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers, 6:17004 (CONF-800483—(Vol.2))
Air Pollution Control
New source performance standards for industrial boilers. Volume 1. Analysis of fuel use implications, 6:17386 (ANL/EES-TM—103)
Design
Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980, 6:16793 (DOE/GFETC/10059—2)
Economic Analysis
Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980, 6:16793 (DOE/GFETC/10059—2)
Efficiency
Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2))
Energy Efficiency
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Practical procedures for auditing industrial boiler plants, 6:17002 (CONF-800483—(Vol.2))
Energy Management
Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2))
Field Tests
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)

Fouling
Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980, 6:16793 (DOE/GFETC/10059—2)
Fuel Substitution
Coal gasification of a central heating plant (U. of Minnesota, Duluth campus; gas and oil firing), 6:16393
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
New source performance standards for industrial boilers. Volume 1. Analysis of fuel use implications, 6:17386 (ANL/EES-TM—103)
Fuel-Air Ratio
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Licensing
Licensing of district heating boilers: the Minnegasco Energy Center, Minneapolis, Minnesota experience, 6:17051
Modifications
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 1. Technical results. Final report, March 1977-May 1978, 6:16801 (PB—80-220957)
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 2. Appendices. Final report, March 1977-May 1978, 6:17244 (PB—80-212939)
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)
Optimization
Industrial-boiler optimization utilizing CO control, 6:17018 (CONF-800483—(Vol.2))
Performance
Review of new source performance standards for coal-fired utility boilers, phase three report, sensitivity studies for the selection of a revised standard. Final report, 6:16797 (PB—80-213036)
Permits
Licensing of district heating boilers: the Minnegasco Energy Center, Minneapolis, Minnesota experience, 6:17051
Radiant Heat Transfer
Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)
Standards
New source performance standards for industrial boilers. Volume 1. Analysis of fuel use implications, 6:17386 (ANL/EES-TM—103)
Review of new source performance standards for coal-fired utility boilers, phase three report, sensitivity studies for the selection of a revised standard. Final report, 6:16797 (PB—80-213036)
Thermal Efficiency
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 1. Technical results. Final report, March 1977-May 1978, 6:16801 (PB—80-220957)
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 2. Appendices. Final report, March 1977-May 1978, 6:17244 (PB—80-212939)
Wood Burning Furnaces
Wood-coal fired small boiler case study, 6:16996 (CONF-800483—(Vol.2))
BOILING WATER REACTORS
See BWR TYPE REACTORS
BONNER SPHERE DETECTORS
Calibration
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Design
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Operation
Evaluate existing radiation fields, 6:17311 (PNL—3536)
BOREHOLE LINKING
Economic Analysis
Relative merits of alternate linking techniques for underground coal gasification and their system design implications, 6:16377
BOREHOLES
Reverse Combustion
Reverse combustion in a borehole, 6:16391
BORON
Chemical Vapor Deposition
Chemical vapor deposition of boron at low temperatures, 6:17144 (SAND—81-0475C)
BORON 10 TARGET
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
BORON 11 TARGET
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
BOUNDARIES (GRAIN)
See GRAIN BOUNDARIES
BRAIN
Biological Evolution
Role of brain maturation and reproductive history in the evolution of the primate brain, 6:17500 (CONF-8004147—1)
Blood Flow
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Radionuclide Kinetics
Metabolic mapping of the brain's response to visual stimulation: studies in humans, 6:17515
Scintiscanning
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
BRAZIL
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)
BRAZING ALLOYS
Performance Testing
Metallurgical study for University of California Lawrence Livermore Labs. (SS 304 to 21-6-9), 6:17116 (UCRL—15318)
BREASTS
See MAMMARY GLANDS
BRINES
Solvent Properties
Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—)
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
Thermodynamic Properties
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
BROMATES
Reduction
Existence of solitary traveling wave solutions of a model of the Belousov-Zhabotinskii reaction, 6:17175
BROMINATED ALIPHATIC HYDROCARBONS
Mutagenesis
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
NMR Spectra
Experiments on selective excitation of multiple-quantum transitions in NMR spectroscopy, 6:17617
BROMINE
Stratosphere
First measurements of total chlorine and bromine in the lower stratosphere, 6:17566
BROMINE 77
Radiopharmaceuticals
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492

Scintiscanning
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492

BROMINE 82
Evaluation
Apparatus and method for downhole injection of radioactive tracer (Patent), 6:17324
Irradiation Capsules
Apparatus and method for downhole injection of radioactive tracer (Patent), 6:17324

BRONCHI
Dynamic Function Studies
Evaluation of the physical properties of monodisperse and heterodisperse aerosols used in the assessment of bronchial function, 6:17503 (UR—3490-1977)

BROOKHAVEN AGS
(Alternating-Gradient Synchrotron.)
Beam Bending Magnets
Tests of a 3 meter curved superconducting beam transport dipole magnet, 6:17263 (BNL—29174)
Beam Dynamics
Acceleration of polarized protons in the Brookhaven AGS, 6:17255 (BNL—29295)
Kicker Magnets
AGS fast kicker magnet system, 6:17265 (BNL—29187)
Polarized Beams
Acceleration of polarized protons in the Brookhaven AGS, 6:17255 (BNL—29295)
Proton Beams
Acceleration of polarized protons in the Brookhaven AGS, 6:17255 (BNL—29295)
Septum Magnets
New AGS slow external beam switchyard, 6:17264 (BNL—29176)

BUILDINGS
See also APARTMENT BUILDINGS
COMMERCIAL BUILDINGS
GREENHOUSES
HOUSES
OFFICE BUILDINGS
PUBLIC BUILDINGS
RESIDENTIAL BUILDINGS
SCHOOL BUILDINGS
Cooling Load
Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final), 6:16973 (PB—80-213424)
Damage
Design optimization in underground coal systems. Volume VII. Prediction of mining subsidence and related parameters over longwall mining operations. Final technical report, 6:16411 (FE—1231-25)
Energy Analysis
Overview of validation procedures for building energy-analysis simulation codes, 6:16978 (SERI/TP—721-1133)
Unified interzone and system coupling methodology for building energy analysis. Final report, 6:16961 (DOE/SF/10840—T1)
Energy Conservation
Validation of thermal-energy-savings calculations in the SECP handbook. Final report, 6:16959 (DOE/EI/10416—1)
Energy Efficiency
Energy efficient building programs, 6:16963 (LBL—11650)
Energy efficiency studies: building energy performance standards for residential buildings, 6:16905 (LBL—11972)
Heating Load
Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final), 6:16973 (PB—80-213424)
Research Programs
Energy efficient building programs, 6:16963 (LBL—11650)
Thermal Efficiency
Validation of thermal-energy-savings calculations in the SECP handbook. Final report, 6:16959 (DOE/EI/10416—1)
Water Source Heat Pumps
Combination central heat steam and heat pump installation. A comparison of a school with and without heat recovery, 6:16979

BUNKER OILS
See RESIDUAL FUELS
BUNKERS
See HOPPERS
BUREAU OF MINES
See US BUREAU OF MINES
BURNERS
See also FLUIDIZED-BED COMBUSTORS
GAS BURNERS
Design
Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Energy Efficiency
High-efficiency burners by retrofit: a simple inexpensive way to improve combustion efficiency, 6:16995 (CONF-800483—(Vol.2))
Modifications
Multi-fuel low-NO/sub x/ burner development. Phase I. Final report, November 1978-March 1980, 6:17248 (PB—80-219587)
Performance Testing
Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Retrofitting
High-efficiency burners by retrofit: a simple inexpensive way to improve combustion efficiency, 6:16995 (CONF-800483—(Vol.2))

BUTANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)

BUTANOLS
Biosynthesis
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)

BUTYL ALCOHOLS
See BUTANOLS
BUTYRIC ALCOHOLS
See BUTANOLS

BWR TYPE REACTORS
See also PEACH BOTTOM-3 REACTOR
Acoustic Monitoring
Experimental study of advanced continuous acoustic emission monitoring of BWR components. Final report, 6:16827 (DOE/ET/34216—T1)
Annular Fuel Elements
Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers, 6:16829 (GEAP—24310)
Control Rooms
Use of task analysis in control room evaluations, 6:16852 (CONF-810411—)
ECCS
Graphic display of spatially distributed binary-state experimental data, 6:16861 (CONF-810235—1)
Flowmeters
Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
Fuel Rods
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
In-Service Inspection
Experimental study of advanced continuous acoustic emission monitoring of BWR components. Final report, 6:16827 (DOE/ET/34216—T1)
Loss of Coolant
Graphic display of spatially distributed binary-state experimental data, 6:16861 (CONF-810235—1)
TRAC-BD1: transient reactor analysis code for boiling-water systems, 6:16862 (CONF-810307—3)

Pressure Suppression
Review of proposed improvements, including filter/vent of BWR pressure-suppression and PWR ice containments. Final report, 6:16871 (EPRI-NP—1747)
Reactor Instrumentation
Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
Reactor Internals
Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers, 6:16829 (GEAP—24310)
Reactor Safety
Light water reactor safety technology program. Quarterly report, October-December 1980, 6:16874 (SAND—81-0473)

C

CADMIUM
Activation Analysis
Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)
Biological Effects
Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)
Body Burden
Programs and subroutines for calculating cadmium body burdens based on a one-compartment model, 6:16854 (BNL—51306)
Quantitative Chemical Analysis
Critical organ concentration of cadmium in occupationally-exposed workers, 6:17526 (BNL—29066)
Toxicity
Critical organ concentration of cadmium in occupationally-exposed workers, 6:17526 (BNL—29066)
CADMIUM COMPOUNDS
Biological Effects
LA-UR—81-859 (CHO cells), 6:17529 (CONF-810350—1)
CADMIUM SELENIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
CADMIUM SULFIDE SOLAR CELLS
Fabrication
Development of copper sulfide/cadmium sulfide thin-film solar cells, 6:16660 (SERI/PR—8143-1-T3)
Emerging material systems for solar-cell applications. Technical progress report No. 3, 17 October 1979-16 January 1980, 6:16641 (DOE/ET/23003—3)
CADMIUM SULFIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
Vacuum Coating
Development of copper sulfide/cadmium sulfide thin-film solar cells, 6:16660 (SERI/PR—8143-1-T3)
CADMIUM TELLURIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
CAES
See COMPRESSED AIR ENERGY STORAGE
CALCINED WASTES
X-Ray Fluorescence Analysis
Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9), 6:16571 (UCID—18845)
CALCIUM
Atom-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Ion-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Theoretical investigations of the collision dynamics in H^- formation and destruction, 6:17571 (BNL—51304)
Neutron Reactions
Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis (35 to 50 MeV), 6:17702 (DOE/NDC—21/L(Vol.1))
CALCIUM 40
Excitation Functions
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
Isotope Separation
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))
CALCIUM 40 TARGET
Alpha Reactions
Nuclear structure approach to the calculation of the imaginary alpha-nucleus optical potential (31 and 100 MeV), 6:17701 (DOE/ER/10405—2)
Beryllium 9 Reactions
Nuclear structure of high-spin states in ^{46}Ti and ^{46}V, 6:17705
CALCIUM 48
Isotope Separation
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))
CALCIUM ISOTOPES
Thermal Diffusion
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
CALIBRATION STANDARDS
Evaluation
Introduction, 6:17306 (PNL—3536)
CALIFORNIA
See also GEYSERS GEOTHERMAL FIELD
LONG VALLEY
Air Quality
Transportation systems and regional air quality - photochemiCal modeling of Sacramento, California region. Interim report, April 1976-October 1979, 6:17359 (PB—80-210800)
Alcohol Fuels
Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)
Electric Power
Electricity tommorrow. 1981 final report, summary, 6:16937
Energy Consumption
California energy flow in 1979, 6:16955 (UCID—18991)
Energy Management
State government leadership: California as a model of sound energy practice. Executive summary , 6:16918
Energy Policy
Energy and transportation: issues for California, 6:16984
Local government energy programs: status, opportunities, and recommendations for state support, 6:16919
State government leadership: California as a model of sound energy practice. Executive summary , 6:16918
Residential Buildings
Proposed residential building standards: draft environmental impact report, 6:16969 (P—700-80-013)
Transportation Systems
Energy and transportation: issues for California, 6:16984
Water Resources
Water resources appraisals for hydroelectric licensing: American River Basin, California. Planning status report, 6:16623 (FERC—0076)
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Wind Power Plants
Community wind electrical power case study: Muir Beach. Final report, 6:16779 (DOE/SF/01963—T2)
Wind Turbines
Guide to financial assistance for wind energy, 6:16771 (P—500-81-014)
CALIFORNIUM 252
Energy Spectra
Phantom position dependence, 6:17312 (PNL—3536)
CALORIMETERS (PARTICLE)
See SHOWER COUNTERS

CAMERAS
Calibration
Pulsed versus direct current calibration of a proximity focused x-ray streak camera, 6:17764 (LA—8425-MS)
CANCER
See NEOPLASMS
CANONICAL EQUATIONS
See DIFFERENTIAL EQUATIONS
CAPACITORS
Electrical Insulation
Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)
CAPE KENNEDY
Meteorology
Cape Canaveral sea breezes, 6:17348
CARBON
See also GRAPHITE
Corrosion
Stability of acid-fuel-cell cathode materials. Work period: January 1, 1978-December 31, 1979, 6:16950 (EPRI-EM—1664)
Deposition
Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980, 6:16354 (DOE/ET/14815—20)
Investigation of carbon deposition on fluidized methanation catalysts. Appendix, 6:16355 (DOE/ET/14815—20)
Industrial Radiography
Method of evaluating the integrity of the outer carbon layer of triso-coated reactor fuel particles (Patent), 6:16552
Ion-Atom Collisions
Energy dependence of alignment in foil collision-excited n = 3 states of He I, 6:17605
Molecular effects in beam-foil collision-induced alignment of He I, 6:17606
Neutron Reactions
Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis (35 to 50 MeV), 6:17702 (DOE/NDC—21/L(Vol.1))
Neutron-induced charged particle measurements from carbon, nitrogen, and oxygen at UC, Davis (27.4 to 60.7 MeV), 6:17694 (DOE/NDC—21/L(Vol.1))
Sorptive Properties
Demonstration of carbon adsorption technology for petroleum dry cleaning plants. Final report, October 1977-April 1979, 6:16502 (PB—80-221039)
Physical adsorption: rare gas atoms on solid surfaces. Progress report, June 1, 1980-May 31, 1981, 6:17596 (DOE/ER/10454—1)
CARBON 11
Radioisotope Scanning
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
CARBON 12
Excitation Functions
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
Giant Resonance
Giant resonance studies with high energy heavy ions, 6:17697 (INKA-Conf—79-001-000)
CARBON 12 REACTIONS
Nucleosynthesis
Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727
CARBON 12 TARGET
Gadolinium 158 Target
Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)
Neutron Reactions
Cross sections for the reactions of $^{9}Be(n,t_1\gamma)$ and $^{12}C(n,n'\gamma)$ between 13.0 and 15.0 MeV, 6:17696 (DOE/NDC—21/L(Vol.1))
Neutron induced charged particle reaction studies at Ohio University, 6:17703 (DOE/NDC—21/L(Vol.1))
Oxygen 16 Reactions
Giant resonance studies with high energy heavy ions (315 MeV), 6:17697 (INKA-Conf—79-001-000)
CARBON 13
Excitation Functions
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
Excretion
Fecal ^{13}C analysis for the detection and quantitation of intestinal malabsorption, 6:17495
Isotopic Exchange
Alumina-catalyzed isotope exchange in CO/sup 1 2/, 6:17182
Nuclear Magnetic Resonance
Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)
Uses
Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497
CARBON 13 TARGET
Gadolinium 157 Target
Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Proton Reactions
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
CARBON 14
Energy-Level Transitions
Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
CARBON 14 COMPOUNDS
Autoradiography
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
CARBON 14 TARGET
Pion Reactions
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
CARBON DIOXIDE
Abundance
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
Electrochemistry
Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981, 6:17185 (DOE/ER/02960—T1)
Environmental Impacts
Climate change and society: consequences of increasing atmospheric carbon dioxide, 6:17448 (DOE/EV/10281—T3)
Mass Transfer
Flax pond ecosystem study: exchanges of CO_2 between a salt marsh and the atmosphere, 6:17400
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)
Phase behavior of CO_2 and crude oil in low temperature reservoirs, 6:16478 (CONF-8004140—)
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Solubility
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Solubilities of acid gases and nitrogen in methanol. Final report, September 1979-April 1980, 6:16616 (PB—80-212236)

Viscosity
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)

CARBON DIOXIDE ACCEPTOR PROCESS
Valves
BI-GAS gasification process and valve requirements, 6:16364 (DOE/MC/14522—1)

CARBON DIOXIDE INJECTION
Displacement of oil by carbon dioxide, 6:16489 (NP—25370)
Bench-Scale Experiments
Development of mobility control methods to improve oil recovery by CO_2. First annual report, October 1, 1979-September 30, 1980, 6:16488 (DOE/MC/10689—5)
Evaluation
Evaluation of the potential for EOR using CO_2 in North Sea reservoirs, 6:16477 (CONF-8004140—)
Field Tests
Weeks Island S Sand Reservoir B gravity stable tertiary CO_2 displacement, Iberia Parish, Louisiana, 6:16476 (CONF-8004140—)
Research Programs
Development of mobility control methods to improve oil recovery by CO_2. First annual report, October 1, 1979-September 30, 1980, 6:16488 (DOE/MC/10689—5)

CARBON DIOXIDE LASERS
Gas Flow
Fluid mechanics of fusion lasers. Final report, September 11, 1978-June 5, 1980, 6:17220 (DOE/DP/40070—1)

CARBON ISOTOPES
Isotope Separation
Generalized computer model of the transient behavior of multicomponent isotope-separation cascades, 6:16550 (MLM—2816(OP))

CARBON MONOXIDE
Abundance
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
Air Pollution Control
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)
Chemical Analysis
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Chemisorption
Chemisorption of carbon monoxide on reduced molybdena, 6:17173
Combustion
Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Methanation
Studies of the hydrogenation of small unsaturated molecules using organometallic cluster compounds as catalysts, 6:16604 (DOE/ER/04900—1)
Photoionization
Molecular beam photoionization study of CO, N_2, and NO dimers and clusters, 6:17612
Production
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)

CARBON OXYSULFIDE
Hydrolysis
Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes, 6:16375 (FE—2806-16)

CARBON STEELS
Corrosion
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)

CARBONATES
Electrochemistry
Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981, 6:17185 (DOE/ER/02960—T1)

CARBONYL SULFIDE
See CARBON OXYSULFIDE

CARBOXYLIC ACID ESTERS
Diagnostic Uses
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

CASKS
Materials Testing
Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
Shock Absorbers
Device for absorbing mechanical shock (Patent), 6:17207

CATALYSIS
Effects of curvature on asymmetric steady states in catalyst particles, 6:17163 (ANL—81-7)

CATALYSTS
See also ELECTROCATALYSTS
Deactivation
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
Investigation of carbon deposition on fluidized methanation catalysts. Appendix, 6:16355 (DOE/ET/14815—20)
Particle Size
Determination of metal crystallite size and morphology in supported nickel catalysts, 6:17172
Performance Testing
Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980, 6:16354 (DOE/ET/14815—20)
Recovery
Exxon catalytic coal-gasification process development program. Quarterly technical progress report, October-December 1979, 6:16350 (DOE/ET/13005—T2)
Regeneration
Investigation of carbon deposition on fluidized methanation catalysts. Appendix, 6:16355 (DOE/ET/14815—20)
Research Programs
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)

CATALYTIC CONVERTERS
Enforcement
Analysis of options to limit air quality degradation due to misuse of leaded gasoline in cars equipped with catalytic converters. Paper (final), 6:17390 (PB—80-212780)
Papers related to gasoline supply, misfueling and environmental air quality for the summer of 1979. Paper (final), 6:17391 (PB—80-212798)
Fuel Substitution
Analysis of options to limit air quality degradation due to misuse of leaded gasoline in cars equipped with catalytic converters. Paper (final), 6:17390 (PB—80-212780)
Papers related to gasoline supply, misfueling and environmental air quality for the summer of 1979. Paper (final), 6:17391 (PB—80-212798)

CATALYTIC CRACKING
Computerized Simulation
Fluid catalytic-cracking power-recovery dynamic computer simulation, 6:17010 (CONF-800483—(Vol.2))
Energy Recovery
Fluid catalytic-cracking power-recovery dynamic computer simulation, 6:17010 (CONF-800483—(Vol.2))

CATHODES
Corrosion
Stability of acid-fuel-cell cathode materials. Work period: January 1, 1978-December 31, 1979, 6:16950 (EPRI-EM—1664)
CATTLE
Data Acquisition Systems
Electronic weighing, identification and subdermal body temperature sensing of range livestock, 6:17511 (LA-UR—81-748)
CAUSTIC FLOODING
Demonstration Programs
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 1. Body of report, 6:16482 (DOE/ET/12047—52(Vol.1))
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 2. Appendix I, 6:16483 (DOE/ET/12047—52(Vol.2))
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 3. Appendices II-XVII, 6:16484 (DOE/ET/12047—52(Vol.3))
CAVITIES
See also BOREHOLES
CRATERS
SALT CAVERNS
Backfilling
Backfilling of cavities resulting from borehole mining, 6:16434
CAVITY RESONATORS
Electric Impedance
ISABELLE cavity gap assemblies, 6:17285 (BNL—29091)
CELL CYCLE
Biological Radiation Effects
Cell cycle kinetics in human lymphocyte cultures, 6:17518
Temperature Effects
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486
CELL MEMBRANES
Electron Transfer
Direct observation of electron transfer across a lipid bilayer: laser photolysis of an asymmetric vesicle system containing chlorophyll, methyl viologen, and EDTA, 6:17466 (DOE/ER/04927—T1)
Nuclear Magnetic Resonance
Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)
Pigments
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)
Proteins
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)
Uptake
Threshold effects and cellular recognition. Progress report, 6:17489 (DOE/EV/10268—1)
CELL PROLIFERATION
Molecular Biology
Cellular proliferation and regeneration following tissue damage. Final report, 6:17502 (DOE/EV/02401—T1)
Stimulation
Cell cycle kinetics in human lymphocyte cultures, 6:17518
CELLS (ANIMAL)
See ANIMAL CELLS
CELLS (ELECTROLYTIC)
See ELECTROLYTIC CELLS
CELLS (PLANT)
See PLANT CELLS
CELLULASE
Biochemical Reaction Kinetics
Fundamental study of the mechanism and kinetics of cellulose hydrolysis by acids and enzymes. Final report, June 1, 1978-January 31, 1981, 6:17465 (DOE/ER/02755—5)
Biosynthesis
Fundamental study of the mechanism and kinetics of cellulose hydrolysis by acids and enzymes. Final report, June 1, 1978-January 31, 1981, 6:17465 (DOE/ER/02755—5)
CELLULOSE
Bioconversion
Chemical Process Research and Development Program, 6:16615 (LBL—11650)
Enzymatic Hydrolysis
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)
Fundamental study of the mechanism and kinetics of cellulose hydrolysis by acids and enzymes. Final report, June 1, 1978-January 31, 1981, 6:17465 (DOE/ER/02755—5)
Field Tests
Field investigation of the performance of residential retrofit insulation, 6:16965 (NBS-TN—1131)
Isotope Ratio
Oxygen isotope ratios in trees reflect mean annual temperature and humidity, 6:17517
CEMENTS
Comparative Evaluations
Inorganic cement for mine roof-bolt grouting, 6:16423 (BM-RI—8494)
Creep
Creep of monolithic refractory materials. Final report, 6:16370 (DOE/OR/13405—T1)
Performance Testing
Inorganic cement for mine roof-bolt grouting, 6:16423 (BM-RI—8494)
CENTRAL HEATING PLANTS
See also DISTRICT HEATING
Address at the IDHA conference, 6:17047
Performance
Combination central heat steam and heat pump installation. A comparison of a school with and without heat recovery, 6:16979
CENTRAL RECEIVER TEST FACILITY
Operation
Operating experience at the Central Receiver Test Facility (CRTF), 6:16717 (SAND—80-2504C)
CENTRAL REGION
Interconnected Power Systems
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
CENTRIFUGE ENRICHMENT PLANTS
Safeguards
Selection of potential IAEA inspection strategies involving cascade access at the Portsmouth Gas Centrifuge Enrichment Plant (GCEP), 6:16584 (K/OA—4955)
CERAMICS
Corrosion
Ceramic corrosion/erosion project description, 6:16368 (DOE/METC/SP—111)
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)
Erosion
Ceramic corrosion/erosion project description, 6:16368 (DOE/METC/SP—111)
Fabrication
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
Fracture Properties
Applications of scanning electron microscopy to failure analysis in ceramics and glasses, 6:17125 (SAND—81-0063C)
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
Joining
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Laser Beam Machining
Laser machining of ceramic, 6:17235 (BDX—613-2507)

Microstructure
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
Production
Wet chemical method for the production of synthetic raw materials and homogeneous powders for physical-chemical studies, 6:17167 (IS-Trans—111)
Research Programs
High-temperature properties and processes in ceramics: thermomigration. Annual report, January 1, 1980-December 31, 1980, 6:17119 (DOE/ER/02923—4)

CERIUM
Environmental Transport
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
Sorption
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)

CERN II SYNCHROTRON
See CERN SPS SYNCHROTRON

CERN SPS SYNCHROTRON
Neutrino Beams
Some results from the charm neutrino experiment at the CERN SPS, 6:17637 (SLAC—239)

CESIUM
Atom Collisions
Low work function surface for improving the yield of negative hydrogen ions, 6:17578 (BNL—51304)
Atom-Atom Collisions
Negative ion production by charge exchange of hydrogen clusters with a cesium vapor target-status report, 6:17587 (BNL—51304)
Atomic Beams
Cesium supersonic jet for D^- production by double electron capture, 6:17588 (BNL—51304)
Ion Collisions
Conceptual D^- source exploiting negative surface ionization of deuterons, 6:17584 (BNL—51304)
Ion-Atom Collisions
Cesium supersonic jet for D^- production by double electron capture, 6:17588 (BNL—51304)
Limiting secondary plasma effects in cesium cells or jets used in the double charge exchange method for D^- beam production, 6:17573 (BNL—51304)
Production of D^- ions by double charge exchange of D^+ on cesium, 6:17586 (BNL—51304)
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)

CESIUM 114
Nuclear Structure
Recent experiments at the GSI on-line separator, 6:17709

CESIUM 137
Decontamination
Russian experience, 6:17402 (CONF-791234—)
Radioecological Concentration
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
Radionuclide Migration
Increased cesium uptake by water tupelo under inundated conditions, 6:17443
Root Absorption
Increased cesium uptake by water tupelo under inundated conditions, 6:17443

CESIUM CHLORIDES
Polarizability
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)

CESIUM COMPOUNDS
Fermi Level
Fermi-surface measurements of mixed-valent $CeSn_3$, 6:17112

CESIUM FLUORIDES
Polarizability
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)

CESIUM HYDRIDES
Ion Collisions
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)

CESIUM HYDROXIDES
Ion Collisions
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)

CESIUM IONS
Collisions
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)

CESR STORAGE RING
Performance
Results from CESR, 6:17303 (SLAC—239)
Superconducting Cavity Resonators
High energy e^+e^- collider at Cornell using superconducting RF cavities, 6:17301 (SLAC—239)
Target Chambers
Results from CESR, 6:17303 (SLAC—239)

CHALKS
See LIMESTONE

CHARGED PARTICLE DETECTION
See also BETA DETECTION
Telescope Counters
Neutron induced charged particle reaction studies at Ohio University, 6:17703 (DOE/NDC—21/L(Vol.1))

CHARGED PARTICLES
See also DEUTERONS
Energy Losses
Instrumentation, 6:17741 (SLAC—239)

CHARGED-PARTICLE ACTIVATION
See CHARGED PARTICLES

CHARGING (REACTOR)
See REACTOR FUELING

CHARM PARTICLES
See also CHARMED MESON RESONANCES
Lifetime
Review of experiments on charmed particle lifetimes, 6:17641 (SLAC—239)
Photoproduction
Virtual photoproduction of hidden and open charm, 6:17640 (SLAC—239)
Quark Model
Weak decays of strange and heavy quarks, 6:17660 (SLAC—239)
Weak Hadronic Decay
Why most flavor-dependence predictions for nonleptonic charm decays are wrong: flavor symmetry and final-state interactions in nonleptonic decays of charmed hadrons, 6:17653 (ANL-HEP-CP—80-64)

CHARMED MESON RESONANCES
Particle Production
Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647
Semileptonic Decay
Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647

CHARS
Corrosive Effects
Corrosion of metals in coal char environments (FMC, Husky, and Synthane chars), 6:16379 (LBL—12152)
Gasification
Peat gasification: IGT work progress, 6:16607 (TR—80/031-001)

CHEMICAL EFFLUENTS
Monitoring
Handbooks on effluent and environmental monitoring, 6:17385 (PNL—3700(Pt.5))

CHEMICAL EXPLOSIVES
See also PETN
TATB

Detonations
Initiation of explosives: a multi-layered problem in detonation physics, 6:17340 (UCRL-Trans—11661)
Differential Thermal Analysis
Thermal analysis investigations of B/$CaCrO_4$, 6:17339 (MLM—2811)
Extrusion
Study of PETN/LX-13 from semi-continuous recrystallized Mil. Spec. PETN, 6:17336 (MHSMP—81-08)
Performance Testing
Flyer sensitivity test, 6:17337 (MHSMP—81-09)
Sensitivity
Flyer sensitivity test, 6:17337 (MHSMP—81-09)

CHEMICAL HEAT PUMPS
Absorption Refrigeration Cycle
Use of an open-cycle absorption system for heating and cooling, 6:16703 (SERI/TP—631-1159)
Coefficient of Performance
Use of an open-cycle absorption system for heating and cooling, 6:16703 (SERI/TP—631-1159)
Open-Cycle Systems
Use of an open-cycle absorption system for heating and cooling, 6:16703 (SERI/TP—631-1159)

CHEMICAL INDUSTRY
Energy Conservation
Practical approach to process analysis and improvement for energy conservation, 6:17026 (CONF-800483—(Vol.2))
Energy Efficiency
Energy conservation in French industry and at Rhone-Poulenc, 6:17019 (CONF-800483—(Vol.2))
Use of a conversational computer program in operator training for improved energy efficiency, 6:17025 (CONF-800483—(Vol.2))
Energy Management
Energy conservation in French industry and at Rhone-Poulenc, 6:17019 (CONF-800483—(Vol.2))
Energy use management: one company's story, 6:17020 (CONF-800483—(Vol.2))
Steam Generation
Industrial-boiler optimization utilizing CO control, 6:17018 (CONF-800483—(Vol.2))

CHEMICAL PLANTS
See also PETROCHEMICAL PLANTS
Energy Conservation
Education and training promote energy conservation, 6:17055 (CONF-800483—(Vol.2))
Pumps
Energy-saving pumping systems in chemical plant design, 6:17028 (CONF-800483—(Vol.2))

CHEMICAL REACTION KINETICS
Transport Theory
Chemical kinetic functional sensitivity analysis: Elementary sensitivities, 6:17171

CHEMICAL REACTIONS
See also ALKYLATION
CORROSION
DESULFURIZATION
FISCHER-TROPSCH SYNTHESIS
HYDROGENATION
METHANATION
PHOTOSYNTHESIS
REFORMER PROCESSES
Infrared Spectra
Comment on "IR lines broadened by chemical exchange", 6:17180
Turbulent Flow
Chemical reaction and turbulence. Progress report, June 1, 1980-May 31, 1981 (O_3+NO reaction), 6:17164 (DOE/ER/10439—2)

CHEMICAL REACTORS
Comparative Evaluations
Modeling in peat gasification, 6:16612 (TR—80/031-001)
Mass Transfer
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow column), 6:16352 (DOE/ET/14801—6)
Radiant Heat Transfer
Combustion air preheat should be more than supply recycling energy, 6:17003 (CONF-800483—(Vol.2))

CHEMICAL VAPOR DEPOSITION
Chemical vapor deposition of boron at low temperatures, 6:17144 (SAND—81-0475C)

CHERENKOV COUNTERS
Efficiency
Particle identification by Cerenkov and transition radiation, 6:17319 (SLAC—239)
Reviews
Particle identification by Cerenkov and transition radiation, 6:17319 (SLAC—239)

CHILDREN
Diet
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)

CHINA
Coal Reserves
China report: economic affairs, No. 110, 6:16895 (JPRS—77198)
Economic Policy
China report: economic affairs, No. 110, 6:16895 (JPRS—77198)
Petroleum Deposits
China report: economic affairs, No. 110, 6:16895 (JPRS—77198)

CHINA CLAY
See KAOLIN

CHLORINE
Stratosphere
First measurements of total chlorine and bromine in the lower stratosphere, 6:17566

CHLORINE 35
Isotope Separation
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))
Thermal Diffusion
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)

CHLORINE 37
Isotope Separation
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))

CHLOROPHYLL
Electron Transfer
Environmental effects on electron transfer from chlorophyll triplet to quinone: role of dielectric constant, viscosity and quinone structure in cellulose acetate films, 6:16640 (DOE/ER/04927—T4)
Photochemistry
Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay, 6:17468 (DOE/ER/04927—T3)
Solar Energy Conversion
Mechanisms of photochemical energy conversion by chlorophyll. Progress report, April 1, 1980-March 30, 1981, 6:17467 (DOE/ER/04927—T2)

CHLOROPLASTS
Photosynthetic Membranes
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)

CHROMATIN
Structural Chemical Analysis
Thermal denaturation of chromatin and lysine copolymer-DNA complexes. Effects of ethylene glycol, 6:17480

CHROMIUM ALLOYS
Corrosion
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Segregation
Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981, 6:17094 (DOE/ER/10430—T1)
Standards
Cobalt-chromium alloy bars and shapes (Wear and corrosion resistance), 6:17114 (NE-M—7-7T(Rev.)(1-81))

CHROMIUM OXIDES
Electrodeposition
Black chromium-molybdenum: a new stable solar absorber, 6:16721
Spectral Reflectance
Black chromium-molybdenum: a new stable solar absorber, 6:16721
CHROMIUM-MOLYBDENUM STEELS
Corrosion Fatigue
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)
Embrittlement
Contract WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9, second annual report, January 1-December 31, 1980, 6:17098 (DOE/ET/13513—T8)
WEC 3.2.3 study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Quarterly report No. 9. Second annual report, January 1-December 31, 1980, 6:17099 (DOE/ET/13513—T9)
Joining
Inelastic behavior of a dissimilar-metal-welded pipe transition joint: comparison of experimental measurements and analytical prediction, 6:16840 (GEFR-SP—148)
Physical Radiation Effects
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
Welded Joints
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)
CHROMODYNAMICS
See QUANTUM CHROMODYNAMICS
CHROMOSOMES
Morphology
Synaptonemal complexes at premeiotic interphase in the mouse spermatocyte, 6:17475
CISTRONS
See GENES
CLAYS
See also KAOLIN
Water Removal
Dewatering of industrial clay wastes, 6:17423 (BM-RI—8498)
CLEAN ROOMS
Surface Cleaning
Clean room wiping cloths, 6:17205 (BDX—613-2566)
CLIMATES
Mathematical Models
General circulation experiment with a coupled atmosphere, ocean and sea ice model, 6:17347
Temperature Effects
Climate change and society: consequences of increasing atmospheric carbon dioxide, 6:17448 (DOE/EV/10281—T3)
CLINTON P ANDERSON MESON PHY. FACILITY
See LAMPF LINAC
CLOSED PLASMA DEVICES
See also STELLARATORS
TOKAMAK DEVICES
TOROIDAL PINCH DEVICES
Helical Configuration
Stabilization of toroidal plasma devices (Patent), 6:17825
CO2 FLOODING
See CARBON DIOXIDE INJECTION
COAL
See also LIGNITE
Alkylation
Coal-transformation chemistry. Fourth quarterly progress report, 6:16371 (DOE/PC/30088—4)
Chemical Analysis
Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, August-October 1980, 6:16396 (DOE/PC/30013—3)
Evaluating and testing the coking properties of coal (Book; 44 references), 6:16394
UCC-ND procedures for analyses of coal, Oak Ridge installations, 6:16399 (Y/DK—263)
Chemical Composition
Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, August-October 1980, 6:16396 (DOE/PC/30013—3)
Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980, 6:16793 (DOE/GFETC/10059—2)
Nitrogenous substances and means of studying the molecular structure of fuels, 6:16401 (ORNL-tr—4725)
Physical and chemical characterization of coal. Final report, May 1978-January 1980, 6:16398 (PB—80-220775)
Chemical Properties
Chemistry and physics of coal utilization - 1980, 6:16400
Chemical Reactions
Coal-transformation chemistry. Fourth quarterly progress report, 6:16371 (DOE/PC/30088—4)
Chemistry
Application of selected chemical reactions to the organic chemistry of coal (Ms thesis; 146 references), 6:16397 (IS-T—948)
Classification
Evaluating and testing the coking properties of coal (Book; 44 references), 6:16394
Coal Preparation
Effect of physical coal cleaning on sulfur content and variability. Final report, June 1978-April 1980, 6:16385 (PB—80-210529)
Coking
Evaluating and testing the coking properties of coal (Book; 44 references), 6:16394
Combustion
Chemistry and physics of coal utilization - 1980, 6:16400
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers, 6:17004 (CONF-800483—(Vol.2))
Reactions of HS radicals important in coal combustion. Project status report, January 1-March 31, 1981, 6:16454 (DOE/TIC—11441)
Comminution
Efficient ultrasonic grinding: a new technology for micron-sized coal. Final report, September 15, 1979-December 14, 1980, 6:16445 (DOE/ER/10466—1)
Density
Structure and stability of coal-oil mixtures and coal-water mixtures. Final report, 6:16455 (EPRI-CS—1695)
Desulfurization
Chemical Process Research and Development Program, 6:16615 (LBL—11650)
Desulfurization of coal by microbiological leaching. Final report, September 1, 1978-June 1, 1980, 6:16381 (NP—25377)
Dissolution
Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C, 6:17183
Electrical Properties
Chemistry and physics of coal utilization - 1980, 6:16400
Freezing
1980 national conference and workshop on coal freezing, 6:16448 (EPRI-WS—80-119)
Hopper popper, 6:16451
Grinding
Efficient ultrasonic grinding: a new technology for micron-sized coal. Final report, September 15, 1979-December 14, 1980, 6:16445 (DOE/ER/10466—1)
Hydrogenation
Chemical Process Research and Development Program, 6:16615 (LBL—11650)
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
Maritime Transport
Pacific bulk commodity transportation system, Volume II. final report, 6:16450 (PB—80-222573)

Market
Coal industry problems. Final report, 6:16458 (EPRI-EA—1746)
Materials Handling
Hopper popper, 6:16451
Kamyr P-D Series Full-Borne Ball Valve METC SOA Test Valve No. A-17 state-of-the-art lockhopper valve-testing and development project, 6:16446 (DOE/METC/SP—125)
Molecular Structure
Chemistry and physics of coal utilization - 1980, 6:16400
Nitrogenous substances and means of studying the molecular structure of fuels, 6:16401 (ORNL-tr—4725)
Oxidation
Novel method for controlled oxidation, 6:16395 (CONF-810308—10)
Petrology
Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, August-October 1980, 6:16396 (DOE/PC/30013—3)
PIXE Analysis
Chemistry and physics of coal utilization - 1980, 6:16400
Production
Coal industry problems. Final report, 6:16458 (EPRI-EA—1746)
Pyrolysis
Chemistry and physics of coal utilization - 1980, 6:16400
Flash pyrolysis of coal through solar heating, 6:16378 (LA-UR—81-764)
Volatile production during preignition coal history. Quarterly progress report, September 1980-December 1980, 6:16372 (DOE/PC/30291—1)
Reduction
Coal-transformation chemistry. Fourth quarterly progress report, 6:16371 (DOE/PC/30088—4)
Research Programs
Basic Coal Sciences Project Advisory Committee report. Final report, October 1979-October 1980, 6:16925 (PB—80-219603)
Structural Chemical Analysis
Novel method for controlled oxidation, 6:16395 (CONF-810308—10)
Sulfur Content
Physical and chemical characterization of coal. Final report, May 1978-January 1980, 6:16398 (PB—80-220775)
Technology Utilization
Application of a methodology for evaluation of intertechnology tradeoffs: an illustrative case study, 6:16899 (ANL/EES-TM—127)
Transport
1980 national conference and workshop on coal freezing, 6:16448 (EPRI-WS—80-119)
Pacific bulk commodity transportation system, executive summary. Final report, 6:16449 (PB—80-222565)

COAL DEPOSITS
Chemical Composition
Data base for the analysis of compositional characteristics of coal seams and macerals. Quarterly technical progress report, August-October 1980, 6:16396 (DOE/PC/30013—3)
Information
Coal resource information. Volume 2, Part 2. Annotation of selected sources. Final report, 6:16419 (EPRI-EA—673(Vol.2Pt.2))
Permeability
Applications of reservoir simulation to in situ coal gasification, 6:16386 (SAND—80-2579)

COAL FINES
Combustion
Parametric study of coal combustor for MHD generator, 6:16941 (DOE/ET/12346—T1)

COAL GASIFICATION
See also BI-GAS PROCESS
CARBON DIOXIDE ACCEPTOR PROCESS
COGAS PROCESS
EXXON GASIFICATION PROCESS
FW-STOIC PROCESS
IN-SITU GASIFICATION
LURGI PROCESS
LURGI SLAGGING PROCESS
MOLTEN SALT COAL GASIFICATION PROCESS
TEXACO GASIFICATION PROCESS
TRI-GAS PROCESS
U-GAS PROCESS
WESTINGHOUSE GASIFICATION PROCESS
Catalysis
Chemistry and physics of coal utilization - 1980, 6:16400
Computerized Simulation
Moving-bed gasification - combined-cycle control study. Volume 1: results and conclusions, Case 1 - air-blown dry-ash operation. Final report, 6:16374 (EPRI-AP—1740(Vol.1))
Corrosive Effects
Corrosion of metals in coal char environments (FMC, Husky, and Synthane chars), 6:16379 (LBL—12152)
Economic Analysis
Economic evaluation of coal gasification for electric power generation (an update). Final report, 6:16373 (EPRI-AP—1725)
Health Hazards
Low-Btu-gasifier emissions toxicology. Status report, June 1980, 6:17533 (LMF—77)
Material Balance
High-mass-flux coal gasifier. First quarterly technical progress report, 28 September-21 December 1979, 6:16351 (DOE/ET/14674—T1)
Pilot Plants
High-mass-flux coal gasifier. First quarterly technical progress report, 28 September-21 December 1979, 6:16351 (DOE/ET/14674—T1)
Technology Assessment
Technology assessment, 6:17453 (PNL—3700(Pt.5))
Test Facilities
High-mass-flux coal gasifier. First quarterly technical progress report, 28 September-21 December 1979, 6:16351 (DOE/ET/14674—T1)

COAL GASIFICATION PLANTS
Demonstration Plants
Policy implications of a shift in Federal synthetic-fuel-demonstration responsibility, 6:16921 (DOE/FE—0015)
Design
Memphis demonstration plant program, 6:16344 (CONF-800878—2)
Flowsheets
Memphis demonstration plant program, 6:16344 (CONF-800878—2)
Values
Test and evaluation of two Sigmon Corporation 6-inch Type K Ball Valves METC SOA Test Valve No. A-4 and METC SOA Test Valve No. B-4 for lockhopper service in coal conversion, 6:16369 (DOE/METC/SP—129)
Valves
BI-GAS gasification process and valve requirements, 6:16364 (DOE/MC/14522—1)
Critical valve specifications and METC valve-testing projects, 6:16367 (DOE/MC/14522—1)
Proceedings of the 2nd symposium on valves for coal conversion and utilization, 6:16357 (DOE/MC/14522—1)
Valve requirements for the ICGG pipeline gas demonstration plant, 6:16362 (DOE/MC/14522—1)

COAL INDUSTRY
Competition
Coal competition: prospects for the 1980s, 6:16457 (DOE/PE—0027(Add.))
Labor Relations
Coal industry problems. Final report, 6:16458 (EPRI-EA—1746)
Reviews
Coal competition: prospects for the 1980s, 6:16457 (DOE/PE—0027(Add.))

COAL LIQUEFACTION
See also EXXON LIQUEFACTION PROCESS
H-COAL PROCESS
SASOL-II PROCESS
Catalysts
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
Chemistry
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)

Coal-transformation chemistry. Fourth quarterly progress report, 6:16371 (DOE/PC/30088—4)

Comparative Evaluations

Technical and economic evaluation of selected coal-liquefaction processes. Phase O. Preliminary screening evaluations, 6:16384 (ORNL/TM—7581)

Technology Assessment

Technology assessment, 6:17453 (PNL—3700(Pt.5))

COAL LIQUEFACTION PLANTS

Demonstration Plants

Policy implications of a shift in Federal synthetic-fuel-demonstration responsibility, 6:16921 (DOE/FE—0015)

Materials Testing

Creep of monolithic refractory materials. Final report, 6:16370 (DOE/OR/13405—T1)

Valves

Critical valve specifications and METC valve-testing projects, 6:16367 (DOE/MC/14522—1)

Development of a packed-bed letdown valve for coal-liquefaction plants, 6:16382 (ORNL/MIT—321)

High-pressure slurry-letdown valve designs for Exxon Coal-Liquefaction Pilot Plant, 6:16359 (DOE/MC/14522—1)

Materials for erosive valve applications, 6:16365 (DOE/MC/14522—1)

Proceedings of the 2nd symposium on valves for coal conversion and utilization, 6:16357 (DOE/MC/14522—1)

Selection and experience to date with block valves for the Exxon Coal-Liquefaction Pilot Plant, 6:16360 (DOE/MC/14522—1)

Slurry-letdown and isolation-valve performance at the Fort Lewis SRC Pilot Plant, 6:16361 (DOE/MC/14522—1)

Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)

Valve requirements and experience in the H-coal liquefaction process, 6:16358 (DOE/MC/14522—1)

COAL LIQUIDS

Bioassay

Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

Chemical Composition

Coal gasification of a central heating plant (U. of Minnesota, Duluth campus; gas and oil firing), 6:16393

Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

Electron Spin Resonance

Chemistry and physics of coal utilization - 1980, 6:16400

Hydrogenation

Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)

Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

Refining

Chemistry and physics of coal utilization - 1980, 6:16400

Stability

Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

Thermodynamic Properties

Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

COAL MINERS

Education

Mine safety analysis and training programs have impact in Kentucky, 6:16442

Occupational Diseases

Black lung benefits program: selected references. Bibliography report, 1970-79, 6:16461 (PB—80-207988)

Training

Cooperation, commitment add up to worker safety at two mines, 6:16437

COAL MINES

Aerosol Monitoring

The application of advanced mine air monitoring techniques to mines using diesel powered equipment. Final report, 1 July 1978-31 July 1979, 6:16429 (PB—80-207541)

Dusts

Measurement and control of respirable dust in mines, 6:16459 (NMAB—363)

Health Hazards

Measurement and control of respirable dust in mines, 6:16459 (NMAB—363)

Pollution Sources

Groundwater quality monitoring of western coal strip mining: preliminary designs for active mine sources of pollution, 6:16414 (PB—80-220502)

COAL MINING

See also ACID MINE DRAINAGE
LONGWALL MINING
SURFACE MINING
UNDERGROUND MINING

Cost

Coal industry problems. Final report, 6:16458 (EPRI-EA—1746)

Environmental Impacts

Effects of subsidence from thick seam coal mining on hydrology. Open file report (final), July 1979-March 1980, 6:16412 (PB—80-219280)

Regulations

Public's rulemaking role starts during earliest conceptual stages, 6:16462

Safety Engineering

Metal/nonmetal safety program proves effective at many mines, 6:16439

Selection of PAR mines based on several factors, 6:16440

COAL PREPARATION

Cost Benefit Analysis

Impact of coal cleaning on the cost of new coal-fired power generation. Final report (Comparison of 7 hypothetical power generation cases), 6:16447 (EPRI-CS—1622)

Efficiency

Effect of physical coal cleaning on sulfur content and variability. Final report, June 1978-April 1980, 6:16385 (PB—80-210529)

Magnetic Separators

Application of coal petrography to the evaluation of magnetically separated dry crushed coals, 6:16444 (CONF-810203—7)

Optimization

Efficient ultrasonic grinding: a new technology for micron-sized coal. Final report, September 15, 1979-December 14, 1980, 6:16445 (DOE/ER/10466—1)

COAL RESERVES

Bibliographies

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Forecasting

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Information

Coal resource information. Volume 2, Part 2. Annotation of selected sources. Final report, 6:16419 (EPRI-EA—673(Vol.2Pt.2))

COAL SEAMS

Degassing

Economic analysis of vertical wells for coalbed methane recovery, 6:16516 (DOE/MC/08089—107)

Mapping

Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 1. Summary report. Final report, 1974-76, 6:16432 (PB—80-219454)

Seismic Surveys

Geophysical methods for coal seam variability detection in front of mining face. Report No. 1, state of the art report, 6:16427 (DOE/TIC—11444)

COAL-DERIVED LIQUIDS

See COAL LIQUIDS

COAL-FIRED MHD GENERATORS
Combustors
Parametric study of coal combustor for MHD generator, 6:16941 (DOE/ET/12346—T1)
COATED FUEL PARTICLES
Industrial Radiography
Method of evaluating the integrity of the outer carbon layer of triso-coated reactor fuel particles (Patent), 6:16552
Physical Radiation Effects
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
COATING (SURFACE)
See SURFACE COATING
COATINGS
See also BLACK COATINGS
REFLECTIVE COATINGS
Chemical Analysis
Reference method 24-determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings. Reference method 25-determination of total gaseous nonmethane organic emissions as carbon. Background information for promulgated test methods. Final report, 6:17358 (PB—80-209778)
Fatigue
Thermal-fatigue testing of coatings for fusion-reactor applications, 6:17108 (SAND—80-2431C)
Materials Testing
Clad materials for fusion applications, 6:17889
Thermal-fatigue testing of coatings for fusion-reactor applications, 6:17108 (SAND—80-2431C)
Physical Radiation Effects
Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors, 6:17115
COBALT
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
COBALT 57
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
COBALT 60
Radioecological Concentration
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
COBALT ALLOYS
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Hydridation
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1980-February 28, 1981 ($LaNi_6$; $LaCo_5$), 6:16599 (DOE/ER/05246—T1)
Standards
Cobalt-chromium alloy bars and shapes (Wear and corrosion resistance), 6:17114 (NE-M—7-7T(Rev.)(1-81))
COBALT IONS
Carbenes
Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O, 6:17618
Chemical Reactions
Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O, 6:17618
COGAS PROCESS
Valves
Valve requirements for the ICGG pipeline gas demonstration plant, 6:16362 (DOE/MC/14522—1)
COGENERATION
Economic Analysis
Cogeneration considerations in the 1980's, 6:17006 (CONF-800483—(Vol.2))
Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2))
Economics
Cogeneration at a practical plant level, 6:16998 (CONF-800483—(Vol.2))
Economics of steam/electric generation, 6:17008 (CONF-800483—(Vol.2))
Energy Conservation
Cogeneration at a practical plant level, 6:16998 (CONF-800483—(Vol.2))
Energy Systems
Cogeneration considerations in the 1980's, 6:17006 (CONF-800483—(Vol.2))
Evaluation
Case studies of industrial cogeneration in the US, 6:17007 (CONF-800483—(Vol.2))
Financial Data
Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2))
COKING
Manuals
Evaluating and testing the coking properties of coal (Book; 44 references), 6:16394
COLD STORAGE
Computerized Control Systems
Computerized control of environmental systems, 6:16957 (CONF-800483—(Vol.2))
COLLIERIES
See COAL MINES
COLLISIONLESS PLASMA
Kink Instability
Theory of m = 1 modes in collisionless plasmas, 6:17804
COLORADO
Magnetic Surveys
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))
Radiometric Surveys
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))
COLORADO PLATEAU
Gravity Surveys
Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau, 6:16737 (LA—8676-T)
Magnetotelluric Surveys
Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau, 6:16737 (LA—8676-T)
COLORADO RIVER BASIN
Water Resources
Planning status report. Water resources appraisals for hydroelectric licensing: Colorado River Basin, Texas, 6:16626 (FERC—0079)
COLUMBIA RIVER BASIN
Stratigraphy
Review of the upper Cenozoic stratigraphy overlying the Columbia River Basalt Group in western Idaho, 6:17545 (RHO-BWI-C—87)
COLUMBIUM
See NIOBIUM
COMBINED-CYCLE POWER PLANTS
Comparative Evaluations
Economic evaluation of coal gasification for electric power generation (an update). Final report, 6:16373 (EPRI-AP—1725)
Computerized Simulation
Moving-bed gasification - combined-cycle control study. Volume 1: results and conclusions, Case 1 - air-blown dry-ash operation. Final report, 6:16374 (EPRI-AP—1740(Vol.1))

Economic Analysis
Economic evaluation of coal gasification for electric power generation (an update). Final report, 6:16373 (EPRI-AP—1725)
Gas Turbines
High-reliability gas turbine combined-cycle development program: Phase I. Final report, 6:16786 (EPRI-AP—1681(Vol.1))
COMBUSTION
See also IN-SITU COMBUSTION
Control Systems
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Efficiency
Oxygen and opacity stack-emission monitoring systems to optimize combustion efficiency and meet EPA requirements, 6:17005 (CONF-800483—(Vol.2))
Oil Pollution Containment
Oil spills, 6:17438 (PNL—3700(Pt.5))
Research Programs
Combustion research, 6:17202 (LBL—11650)
COMBUSTION CHAMBERS
See also COMBUSTORS
Performance
Effects of microwaves on the performance of internal-combustion engines. Final technical report, September 30, 1979-January 31, 1981, 6:17056 (DOE/ET/13116—T13)
COMBUSTION CONTROL
Computerized Control Systems
Industrial-boiler optimization utilizing CO control, 6:17018 (CONF-800483—(Vol.2))
COMBUSTORS
Mathematical Models
Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)
Performance Testing
Parametric study of coal combustor for MHD generator, 6:16941 (DOE/ET/12346—T1)
COMMENSALISM
See SYMBIOSIS
COMMERCIAL BUILDINGS
See also SHOPPING CENTERS
Commercial-energy-use model for the ten US Federal regions (Floor-space-demand forecast to 1995), 6:16911 (ORNL/CON—40)
Energy Accounting
Computerized control of environmental systems, 6:16957 (CONF-800483—(Vol.2))
Energy Conservation
Major models and data sources for residential and commercial sector energy conservation analysis. Final report, 6:16960 (DOE/PE/70044—T2)
Space HVAC Systems
Guide to the energy conservation regulations for new nonresidential buildings, 6:16968 (P—400-80-069)
COMMERCIAL SECTOR
Energy Conservation
Commercial and industrial energy conservation programs in Illinois (Assistance of state government), 6:17023 (CONF-800483—(Vol.2))
Energy Demand
Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
COMMUNITIES
District Heating
Hartford Steam Service Company: annual business report for 1979, 6:17052
Steam Systems
Hartford Steam Service Company: annual business report for 1979, 6:17052
COMMUNITIES (ECOLOGICAL)
See ECOSYSTEMS
COMPOSITE MATERIALS
See also CONCRETE-PLASTIC COMPOSITES
Failure Mode Analysis
Application of Weibull Criterion to failure prediction in compsites, 6:17215 (Y—2235)
Failures
Application of Weibull Criterion to failure prediction in compsites, 6:17215 (Y—2235)
Specific Heat
Thermal conductivity and specific heat of a glass—epoxy composite at temperatures below 4 K, 6:17129
Thermal Conductivity
Thermal conductivity and specific heat of a glass—epoxy composite at temperatures below 4 K, 6:17129
COMPOUNDS (ORGANIC)
See ORGANIC COMPOUNDS
COMPRESSED AIR ENERGY STORAGE
Environmental Impacts
Compressed air energy storage (CAES), 6:17458 (PNL—3700(Pt.5))
COMPUTER CODES
CMS plotter graphics training manual, 6:17891 (BDX—613-2611)
Nuclear model codes and data evaluation, 6:17737 (DOE/NDC—21/L(Vol.1))
A Codes
Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final) (SELECT and ADJUST codes), 6:16973 (PB—80-213424)
C Codes
CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Model-simulation, 6:17367 (PB—80-220833)
CALINE3 - a versatile dispersion model for predicting air pollutant levels near highways and arterial streets. Interim report, 6:17368 (PB—80-220841)
COMMIX-SA-1: a three-dimensional thermohydrodynamic computer program for solar applications (Heat-storage water tanks), 6:16724 (ANL—80-8)
Crater: a computer code for calculating late stage crater formation, 6:17341 (SAND—80-1694)
Fleet-Car Market PENetration Simulator: CPEN user's guide, 6:17064 (BNL—51286)
Comparative Evaluations
Comparison of DOE-2 and TRNSYS solar-heating-system simulation, 6:16705 (SERI/TR—721-822)
Overview of validation procedures for building energy-analysis simulation codes (SUNCAT 2.4, DEROB 4, DOE 2.1, BLAST), 6:16978 (SERI/TP—721-1133)
D Codes
Difference methods for stiff delay differential equations, 6:17896 (DOE/ER/02383—T2)
E Codes
ETA-MACRO: a user's guide (Tool for integrating long-term energy supply/demand projections), 6:16886 (EPRI-EA—1724)
F Codes
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
FEMWASTE: a Finite-Element Model of Waste transport through porous saturated-unsaturated media, 6:16579 (ORNL—5601)
FPPAC: a two-dimensional multispecies nonlinear Fokker-Planck package, 6:17802 (UCRL—85666)
H Codes
HANDYPAK: a histogram and display package (release 6.0) (In Fortran for IBM 370 and VAX/VMS), 6:17899 (SLAC—234)
K Codes
Validation of the Monte Carlo criticality program KENO IV and the Hansen-Roach sixteen-energy-group-cross sections for high-assay uranium systems (KENO IV criticality code), 6:17214 (Y—2234)
P Codes
PLTLIB: graphics library for Tektronix 4025 and 4027 terminals (For PDP-11 and LSI-11 computers), 6:17900 (UCID—18981)

Performance Testing
Application program performance measurements, 6:17625 (UCRL—85677-VUGRAPH)
S Codes
Documentation and analysis of the Schlumberger interactive 1-D inversion program slumb, 6:16730 (DOE/ET/27002—2)
Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final) (SELECT and ADJUST codes), 6:16973 (PB—80-213424)
T Codes
TRAC-BD1: transient reactor analysis code for boiling-water systems, 6:16862 (CONF-810307—3)
U Codes
Unsteady transonic flow past airfoils in rigid-body motion (UFLO5), 6:17226 (DOE/ER—03077-170)
Validation
Overview of validation procedures for building energy-analysis simulation codes (SUNCAT 2.4, DEROB 4, DOE 2.1, BLAST), 6:16978 (SERI/TP—721-1133)
W Codes
WMIN: a computer program to model molecules and crystals in terms of potential energy functions, 6:17169 (ORNL—5747)
COMPUTER GRAPHICS
Graphic display of spatially distributed binary-state experimental data, 6:16861 (CONF-810235—1)
Computer Codes
CMS plotter graphics training manual, 6:17891 (BDX—613-2611)
HANDYPAK: a histogram and display package (release 6.0), 6:17899 (SLAC—234)
PLTLIB: graphics library for Tektronix 4025 and 4027 terminals, 6:17900 (UCID—18981)
COMPUTER OUTPUT DEVICES
Manuals
CMS plotter graphics training manual, 6:17891 (BDX—613-2611)
COMPUTER PROGRAMMING
See PROGRAMMING
COMPUTERIZED TOMOGRAPHY
Comparative Evaluations
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
COMPUTERS
See also IBM COMPUTERS
Calculation Methods
Influence of computer architectures on numerical algorithms, 6:17901 (UCRL—85679)
Design
Influence of computer architectures on numerical algorithms, 6:17901 (UCRL—85679)
Planning
Review and future actions, 6:17902 (UCRL—85680(VUGRAPH))
CONCENTRATOR SOLAR CELLS
Design
Silicon concentrator solar cell development, 6:16657 (SAND—81-7005)
Fabrication
Concentrator-solar-cell development. Final technical report, 27 March 1979-30 March 1980, 6:16656 (SAND—81-7002)
Performance
Silicon concentrator solar cell development, 6:16657 (SAND—81-7005)
CONCRETE-PLASTIC COMPOSITES
Chemical Composition
Polymer-cement geothermal-well-completion materials. Final report, 6:16748 (BNL—51287)
Compression Strength
Polymer-cement geothermal-well-completion materials. Final report, 6:16748 (BNL—51287)
CONCRETES
Creep
Creep of monolithic refractory materials. Final report, 6:16370 (DOE/OR/13405—T1)
Decontamination
Techniques for removing contaminated concrete surfaces, 6:17416 (CONF-791234—)
CONDENSATES
Chemical Composition
Improvements in appliance efficiency. Task IV. Corrosive effects of condensate. Annual report for 1979, 6:16972 (PB—80-210735)
Corrosive Effects
Improvements in appliance efficiency. Task IV. Corrosive effects of condensate. Annual report for 1979, 6:16972 (PB—80-210735)
CONDENSATION (VAPOR)
See VAPOR CONDENSATION
CONDENSED AROMATICS
See also BENZOPYRENE
Photolysis
Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO (Diazabicyclooctane), 6:17188
Reduction
Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO (Diazabicyclooctane), 6:17188
CONGLOMERATES
Mineralogy
Geology and recognition criteria for uranium deposits of the quartz-pebble conglomerate type. Final report, 6:16531 (GJBX—3(81))
Petrology
Geology and recognition criteria for uranium deposits of the quartz-pebble conglomerate type. Final report, 6:16531 (GJBX—3(81))
Stratigraphy
Geology and recognition criteria for uranium deposits of the quartz-pebble conglomerate type. Final report, 6:16531 (GJBX—3(81))
CONNECTORS
Performance Testing
Evaluation of fiber-optic connectors, 6:17213 (UCRL—53116)
CONSERVATION (ENERGY)
See ENERGY CONSERVATION
CONSOLES
Design
Use of task analysis in control room evaluations (BWR), 6:16852 (CONF-810411—)
CONTAINERS
See also CASKS
DEWARS
HOPPERS
PRESSURE VESSELS
Backfilling
Preliminary investigation of the thermal and structural influence of crushed-salt backfill on repository disposal rooms, 6:16562 (ONWI—138)
Design
Diagnostic test systems canister weld joint analysis, 6:17212 (UCID—18750)
Heat Transfer
Preliminary investigation of the thermal and structural influence of crushed-salt backfill on repository disposal rooms, 6:16562 (ONWI—138)
Welded Joints
Diagnostic test systems canister weld joint analysis, 6:17212 (UCID—18750)
CONTAMINATION
(For radioactive contamination only; see also POLLUTION.)
See also SURFACE CONTAMINATION
Side Effects
Environmental effects on the Hanford Multipurpose Personnel Dosimeter, 6:17313 (PNL—3536)
CONTAMINATION (SURFACE)
See SURFACE CONTAMINATION

CONTINENTAL SHELF
Energy Transfer
Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981, 6:17429 (DOE/EV/00639—22)
Mineral Cycling
Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981, 6:17429 (DOE/EV/00639—22)
Natural Gas Deposits
A report to: the President and the Congress, by the National Advisory Committee on Oceans and Atmosphere, annual report (6th) June 30, 1977, 6:16923 (PB—80-209190)
Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)
Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16492 (PB—80-210289)
Alaska OCS socioeconomic studies program. Technical report number 46. Volume 2. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16493 (PB—80-210297)
Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)
Alaska OCS socioeconomic studies program. Technical report number 31. Bering-Norton petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16496 (PB—80-212624)
Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)
Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report, 6:16497 (PB—80-222482)
Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69, 6:16500 (NP—25371)
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
Petroleum Deposits
A report to: the President and the Congress, by the National Advisory Committee on Oceans and Atmosphere, annual report (6th) June 30, 1977, 6:16923 (PB—80-209190)
Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)
Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16492 (PB—80-210289)
Alaska OCS socioeconomic studies program. Technical report number 46. Volume 2. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16493 (PB—80-210297)
Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)
Alaska OCS socioeconomic studies program. Technical report number 31. Bering-Norton petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16496 (PB—80-212624)
Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)
Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report, 6:16497 (PB—80-222482)
Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69, 6:16500 (NP—25371)
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
CONTROL ROOMS
Consoles
Use of task analysis in control room evaluations (BWR), 6:16852 (CONF-810411—)
CONTROL SYSTEMS
(For automated processes including feedback.)
Comparative Evaluations
Moving-bed gasification - combined-cycle control study. Volume 1: results and conclusions, Case 1 - air-blown dry-ash operation. Final report, 6:16374 (EPRI-AP—1740(Vol.1))
COOLERS
See HEAT EXCHANGERS
COOLING TOWERS
Construction
Analysis of construction conditions affecting the structural response of the cooling tower at Willow Island, West Virginia, 6:16790 (PB—80-222631)
Failures
Analysis of construction conditions affecting the structural response of the cooling tower at Willow Island, West Virginia, 6:16790 (PB—80-222631)
Optimization
Optimum mechanical draft wet cooling towers to supplement once-through cooling at selected Missouri River sites, 6:16789 (PB—80-212764)
Plumes
Studies on mathematical models for characterizing plume and drift behavior from cooling towers. Executive summary, 6:17351 (EPRI-CS—1683-SY)
COPPER
Atom Collisions
Low work function surface for improving the yield of negative hydrogen ions, 6:17578 (BNL—51304)
Biological Half-Life
Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb, 6:17439
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Correlations
Serum copper and zinc levels in melanoma patients, 6:17493
Ecological Concentration
Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583
Grain Boundaries
Atomistic studies of grain boundaries with segregated impurities. Progress report, July 1, 1980-June 30, 1981, 6:17091 (DOE/ER/10429—T2)
Impurities
Atomistic studies of grain boundaries with segregated impurities. Progress report, July 1, 1980-June 30, 1981, 6:17091 (DOE/ER/10429—T2)
Joining
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Kapitza Resistance
Comparison of steady-state and second-sound measurements of the Kapitza resistance, 6:17113
Neon 20 Reactions
Fast-particle emission in the deep-inelastic reaction Cu+20Ne at 12.6 MeV/nucleon, 6:17711

Oxidation
Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report, 6:17097 (DOE/ET/10404—2)
Production
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Recycling
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)
Uptake
Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb, 6:17439
X-Ray Fluorescence Analysis
Determinations of lattice and electronic structures of solids by electron scattering. Progress report, 6:17750 (DOE/ER/10440—2)

COPPER 63 TARGET
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Nickel 58 Reactions
Recent experiments at the GSI on-line separator, 6:17709

COPPER 65
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322

COPPER 65 TARGET
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))

COPPER ALLOYS
See also COPPER BASE ALLOYS
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Magnetization
Magnetization of compositionally modulated CuNi films, 6:17111
Segregation
Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981, 6:17094 (DOE/ER/10430—T1)

COPPER BASE ALLOYS
Oxidation
Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report (Cu-6% Ni), 6:17097 (DOE/ET/10404—2)

COPPER ORES
Processing
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)

COPPER SELENIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)

CORALS
Comparative Evaluations
Light-shade adaptation of Stylophora pistillata, a hermatypic coral from the Gulf of Eilat, 6:17426

CORE FLOODING SYSTEMS
Two-Phase Flow
Measurement of transient two-phase flow velocity using statistical signal analysis of impedance probe signals, 6:17225 (CONF-810434—2(Draft))

CORN (MAIZE)
See MAIZE

CORNELL ELECTRON-POSITRON STORAGE RING
See CESR STORAGE RING

CORROSION
Research Programs
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)

CORTEX (ADRENAL)
See ADRENAL GLANDS

COSMIC GAMMA BURSTS
Origin
Collisions of asteroids on neutron stars as a cause of cosmic gamma ray bursts, 6:17563

COSMIC GAMMA SOURCES
See also COSMIC GAMMA BURSTS
Cosmic Ray Detection
Very high energy gamma ray astrophysics. Progress report, August 1, 1980-July 31, 1981, 6:17561 (DOE/ER/10774—1)

COSMIC X-RAY SOURCES
Visible Spectra
AM Herculis: simultaneous x-ray, optical, and near-ir coverage, 6:17564
X-Ray Spectra
AM Herculis: simultaneous x-ray, optical, and near-ir coverage, 6:17564

COSMOLOGY
Neutrinos
Neutrinos and cosmology, 6:17562 (SLAC—239)

COSMOS
See UNIVERSE

COUPLED CHANNEL THEORY
Unitarity
Solution of the unitarity equation with overlapping left and right cuts: a tool for study of the S* and similar systems, 6:17680

COW-MILKERS
See RADIOISOTOPE GENERATORS

CP INVARIANCE
Theoretical studies of high-energy phenomena: analysis of models of CP and T violation. Progress report, February 15, 1980-April 30, 1981, 6:17671 (DOE/ER/10587—1)

CRATERING EXPLOSIONS
Crater: a computer code for calculating late stage crater formation, 6:17341 (SAND—80-1694)

CRATERS
Computerized Simulation
Crater: a computer code for calculating late stage crater formation, 6:17341 (SAND—80-1694)
Configuration
Crater: a computer code for calculating late stage crater formation, 6:17341 (SAND—80-1694)

CRITICALITY
Computer Calculations
Validation of the Monte Carlo criticality program KENO IV and the Hansen-Roach sixteen-energy-group-cross sections for high-assay uranium systems, 6:17214 (Y—2234)

CRITICALITY ACCIDENTS
See RADIATION ACCIDENTS

CRUDE OIL
See PETROLEUM

CRYOGENIC FLUIDS
Breakdown
Laser-induced dielectric breakdown in cryogenic liquids, 6:17152
Fluid Flow
Device for emptying liquid nitrogen dewars, 6:17216
Laser Radiation
Laser-induced dielectric breakdown in cryogenic liquids, 6:17152

CRYOGENS
See CRYOGENIC FLUIDS

CRYSTAL LATTICES
Dislocations
Electron-dislocation interactions at low temperatures. Progress report, 6:17746 (DOE/ER/02305—T1)

CRYSTAL STRUCTURE
See also CRYSTAL LATTICES

Lattice Vibrations
CO_2 laser absorption and saturation studies of molecular impurities in alkali halide crystals, 6:17138 (DOE/DP/40013—1)
CRYSTALS
See also ANHARMONIC CRYSTALS
LIQUID CRYSTALS
Physical Radiation Effects
New photographic technique for observing bulk laser damage, 6:17078 (UCRL—84843)
Potential Energy
WMIN: a computer program to model molecules and crystals in terms of potential energy functions, 6:17169 (ORNL—5747)
CULTURES (TISSUE)
See TISSUE CULTURES
CURIUM 244
Radiation Monitoring
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
CUTTING TOOLS
Bonding
Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
Failures
Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
CYANIDES
Chemical Preparation
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
CYCLOALKANES
Chemical Reactions
Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O, 6:17618
CYCLOHEXANOL
Partition
Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study, 6:17191
CYCLOTRONS
See also ISOCHRONOUS CYCLOTRONS
Beam Dynamics
Numerical calculation of the three dimensional electrical field in the central region of a cyclotron, 6:17256 (DOE/ER/40014—1)
Beam Injection
Numerical calculation of the three dimensional electrical field in the central region of a cyclotron, 6:17256 (DOE/ER/40014—1)
CYLINDRICAL PARABOLIC COLLECTORS
See PARABOLIC TROUGH COLLECTORS
CZECHOSLOVAKIA
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)

D

DAIRY INDUSTRY
Energy Conservation
Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
Energy Consumption
Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
Water Requirements
Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
DARRIEUS ROTORS
Mechanical Transmissions
Vertical-axis wind-turbine drive-train transient dynamics, 6:16781 (SAND—80-2646)
Restraints
Guy cable design and damping for vertical axis wind turbines, 6:16782 (SAND—80-2669C)
DATA ACQUISITION SYSTEMS
Licensee event report sequence coding and search procedure: a training tool, 6:16863 (CONF-810411—)
Construction
Real-Time Digital Data-Acquisition System for determining load characteristics. Volume 2. Operating, programming, and maintenance instructions. Final report, 6:16808 (EPRI-EL—851(Vol.2))
Design
Real-Time Digital Data-Acquisition System for determining load characteristics. Volume 2. Operating, programming, and maintenance instructions. Final report, 6:16808 (EPRI-EL—851(Vol.2))
Performance
Results of an accuracy test of the Mod-II Site Data Acquisition System, 6:16688 (ANL/EES-TM—128)
DATA BASE MANAGEMENT
Comparative Evaluations
Comparative analysis of peat gasification reactor configurations, 6:17906 (TR—80/031-001)
Feasibility Studies
Environmental data reporting system, 6:17446 (PNL—3700(Pt.5))
Meetings
First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS), 6:16878 (CONF-791258—(Summ.))
DC TO AC INVERTERS
See INVERTERS
DECANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)
DECOMMISSIONING
Meetings
Environmental decontamination, 6:17401 (CONF-791234—)
Safety Standards
Criteria development methodology for DOE decommissioning operations, 6:17418 (CONF-791234—)
DOE decommissioning criteria development, 6:17461 (PNL—3700(Pt.5))
Technology Assessment
Environmental decontamination, 6:17401 (CONF-791234—)
DECONTAMINATION
Equipment
Machine technology: a survey, 6:17420 (CONF-791234—)
Meetings
Environmental decontamination, 6:17401 (CONF-791234—)
Planning
Project planning approach, 6:17450 (CONF-791234—)
Technology Assessment
Environmental decontamination, 6:17401 (CONF-791234—)
New decontamination technologies for environmental applications, 6:16581 (CONF-791234—)
Vehicles
Machine technology: a survey, 6:17420 (CONF-791234—)
DEEP INELASTIC HEAVY ION REACTIONS
Differential Cross Sections
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
DEFORMED NUCLEI
E1-Transitions
Particle properties of collective states, 6:17714
Vibrational States
Particle properties of collective states, 6:17714
DEMONSTRATION PLANTS
See also INDUSTRIAL PLANTS
Government Policies
Policy implications of a shift in Federal synthetic-fuel-demonstration responsibility, 6:16921 (DOE/FE—0015)

DEMONSTRATION PROGRAMS
Government Policies
Policy implications of a shift in Federal synthetic-fuel-demonstration responsibility, 6:16921 (DOE/FE—0015)
Petroleum
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 3. Appendices II-XVII, 6:16484 (DOE/ET/12047—52(Vol.3))
DENSIMETERS
Operation
Method for measuring the density of lightweight materials (Patent), 6:17321
DEOXYPENTOSE NUCLEIC ACID
See DNA
DEOXYRIBONUCLEASE
See DNA-ASE
DEOXYRIBONUCLEIC ACID
See DNA
DEPLETED URANIUM
Proton Reactions
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
Proton Transport
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
DESOXYRIBONUCLEIC ACID
See DNA
DESULFURIZATION
See also AI AQUEOUS CARBONATE PROCESS
HOT GAS CLEANUP
LIME-LIMESTONE WET SCRUBBING PROCESSES
Chemical Reactions
Section I: high-temperature desulfurization of fuel gases, 6:16376 (FE—2806-16)
Comparative Evaluations
Economics of four FGD systems. Final report, 6:16794 (EPRI-CS—1677)
DETONATION WAVES
See SHOCK WAVES
Velocimeters
Particle—velocity gauge system for nanosecond sampling rate of shock and detonation waves, 6:17332
DETONATORS
Operation
Initiation of explosives: a multi-layered problem in detonation physics, 6:17340 (UCRL-Trans—11661)
DEUS
(Dual Energy Use Systems.)
See also COGENERATION
Economic Analysis
Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2))
Evaluation
Case studies of industrial cogeneration in the US, 6:17007 (CONF-800483—(Vol.2))
DEUTERIUM
Diffusion
Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Electronic Structure
Spectroscopic B/sub v/ constants for Rydberg states of D_3, 6:17621
Isotope Effects
Evidence for H_2/D_2 isotope effects on Fischer-Tropsch synthesis over supported ruthenium catalysts, 6:17181
Neutral Atom Beam Injection
Merits of D^--based neutral beam injectors for tokamaks, 6:17592 (BNL—51304)
Solubility
Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Spectra
Spectroscopic B/sub v/ constants for Rydberg states of D_3, 6:17621
Uses
Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497
Vapor Pressure
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
Vibrational States
Spectroscopic B/sub v/ constants for Rydberg states of D_3, 6:17621
DEUTERIUM IONS
Charge Exchange
Conceptual D^- source exploiting negative surface ionization of deuterons, 6:17584 (BNL—51304)
Collisions
Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304)
Ion Beams
D^- ion accelerator immersed in a magnetic field, 6:17593 (BNL—51304)
Merits of D^--based neutral beam injectors for tokamaks, 6:17592 (BNL—51304)
Ion-Atom Collisions
Angular scattering in electron capture and loss D^- beam formation processes, 6:17572 (BNL—51304)
Cesium supersonic jet for D^- production by double electron capture, 6:17588 (BNL—51304)
Collision cross sections and equilibrium fractions of ions and atoms in metal vapor targets. Project progress report, June 1, 1979-May 31, 1980, 6:17760 (DOE/ET/53048—3)
Limiting secondary plasma effects in cesium cells or jets used in the double charge exchange method for D^- beam production, 6:17573 (BNL—51304)
Production of D^- ions by double charge exchange of D^+ on cesium, 6:17586 (BNL—51304)
Photon-Ion Collisions
Laser neutralization of negative ion beams for fusion, 6:17591 (BNL—51304)
DEUTERIUM TARGET
Proton Reactions
Deuteron D-wave and the non-eikonal effects in tensor asymmetries in elastic proton-deuteron scattering, 6:17687
Spin rotation and depolarization in the ^{2}H(p vector,p vector)^{2}H reaction and the double-spin-flip part of the NN amplitude, 6:17689
DEUTERON REACTIONS
Compound-Nucleus Reactions
Low energy neutron emission from Be(d,n) and Be(p,n) reactions (10 to 25 MeV), 6:17691 (DOE/NDC—21/L(Vol.1))
Fusion Reactions
Observation of d-^{3}He fusion reactions in a tokamak plasma, 6:17688
Stripping
Characterization of the Be(d,n) neutron field by passive dosimetry techniques, 6:17690 (DOE/NDC—21/L(Vol.1))
Low energy neutron emission from Be(d,n) and Be(p,n) reactions (10 to 25 MeV), 6:17691 (DOE/NDC—21/L(Vol.1))
DEUTERON-DEUTERON INTERACTIONS
See DEUTERIUM TARGET
DEUTERON REACTIONS
DEUTERONS
D States
Deuteron D-wave and the non-eikonal effects in tensor asymmetries in elastic proton-deuteron scattering, 6:17687
DEVONIAN SHALES
See BLACK SHALES
DEWARS
Device for emptying liquid nitrogen dewars, 6:17216
DIAPHRAGMS (THERMONUCLEAR DEVICE)
See LIMITERS

DIATOMS
Population Dynamics
Potential effects of energy related activities on the seasonal trajectories of epiphytic marine diatoms, 6:17463
1,3-DIAZINES
See PYRIMIDINES
DIAZO COMPOUNDS
Photolysis
Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO (Diazabicyclooctane), 6:17188
DIESEL ENGINES
Environmental Impacts
Assessment of environmental impacts of light duty vehicle dieselization. Final report, May 1978-March 1979, 6:17061 (PB—80-220759)
Exhaust Gases
Assessment of diesel particulate control: particle size measurements. Final report, November 1978-November 1979, 6:17062 (PB—80-224256)
Risk Assessment
Potential health and environmental effects of diesel light duty vehicles, 6:17452 (LMF—82)
DIET
Contamination
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
DIFFERENTIAL EQUATIONS
Numerical Solution
Detection and integration of oscillatory differential equations with initial stepsize, order and method selection, 6:17895 (DOE/ER/02383—T1)
Difference methods for stiff delay differential equations, 6:17896 (DOE/ER/02383—T2)
Iterative solution of linear equations in ODE codes (Krylov subspaces), 6:17894 (DOE/ER/02383—0078)
Recent developments in numerical ODES, 6:17898 (SAND—81-0013)
DIFFRACTION MODELS
Cross Sections
Charm production by muons and its role in scale-noninvariance, 6:17630 (DOE/ER/03072—T3)
DIFFUSERS
Heat Transfer
Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)
DIGESTIVE SYSTEM DISEASES
Diagnosis
Fecal ^{13}C analysis for the detection and quantitation of intestinal malabsorption, 6:17495
DIMERS
Photoreactivation
Photoreactivation of pyrimidine dimers in DNA from thyroid cells of the teleost, Poecilia formosa, 6:17522
DIMETHYLKETONE
See ACETONE
DIOLS
See GLYCOLS
DIRECT GAIN SYSTEMS
Design
Optimum utilization of site energy sources for all-season thermal comfort in new residential construction for single-family attached (rowhouse/townhouse) designs, 6:16698 (DOE/R5/10215—1)
DISCHARGING (REACTOR)
See REACTOR FUELING
DISPERSANTS (CHEMICAL)
See SURFACTANTS
DISPERSED STORAGE AND GENERATION
Socio-Economic Factors
Assessment of energy parks vs. dispersed electric power generating facilities. Final report, 15 July 1975-31 December 1976, 6:16936 (PB—80-214273)
Technology Assessment
Assessment of energy parks vs. dispersed electric power generating facilities. Final report, 15 July 1975-31 December 1976, 6:16936 (PB—80-214273)
DISSOLVED GASES
Environmental Effects
Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)
Origin
Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)
DISTILLATION EQUIPMENT
Energy Conservation
Low level heat recovery through heat pumps and vapor recompression, 6:17014 (CONF-800483—(Vol.2))
DISTRIBUTED COLLECTOR POWER PLANTS
Performance
1980 annual report of the Coolidge Solar Irrigation Project, 6:16679 (SAND—80-2378)
DISTRICT HEATING
See also GEOTHERMAL DISTRICT HEATING
Boilers
Licensing of district heating boilers: the Minnegasco Energy Center, Minneapolis, Minnesota experience, 6:17051
Heat Pumps
Heatpumps in steam district heating, 6:17048
Meetings
Proceedings of the International District Heating Association. Volume 71, 6:17046
Pipelines
Piping networks for district heating applications, 6:17049
Reviews
Address at the IDHA conference, 6:17047
Description of district heating: US history and current status, 6:17041 (CONF-810343—1)
Potential for district heating: an historical overview, 6:17042 (CONF-810435—1)
Steam
Heatpumps in steam district heating, 6:17048
DISTRICT OF COLUMBIA
See WASHINGTON DC
DNA
(Deoxyribonucleic acid.)
Biological Radiation Effects
DNA repair in a short- and a long-lived rodent species, 6:17521
Photoreactivation of pyrimidine dimers in DNA from thyroid cells of the teleost, Poecilia formosa, 6:17522
Repair of the ultraviolet-irradiated male genome in fertilized mouse eggs, 6:17516
Biological Repair
Repair of the ultraviolet-irradiated male genome in fertilized mouse eggs, 6:17516
Structural Chemical Analysis
Genetic and physical mapping in the early region of bacteriophage T7 DNA, 6:17488
Sequence organization of the soybean genome, 6:17484
DNA REPLICATION
Biochemical Reaction Kinetics
DNA synthesis in a sub-nuclear preparation isolated from Physarum polycephalum, 6:17477
Biological Radiation Effects
Repair of the ultraviolet-irradiated male genome in fertilized mouse eggs, 6:17516
Radioinduction
Repair of the ultraviolet-irradiated male genome in fertilized mouse eggs, 6:17516
Temperature Effects
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486
DNA-ASE
Inhibition
Deoxyribonuclease I in mammalian tissues (Rats), 6:17472
Tissue Distribution
Deoxyribonuclease I in mammalian tissues (Rats), 6:17472

DOMED STRUCTURES
Evaluation
Energy issues relevant to domed cities, Winooski, Vermont: a case study, 6:17043 (CONF-8003107—2)
DOPED MATERIALS
Lattice Vibrations
CO_2 laser absorption and saturation studies of molecular impurities in alkali halide crystals, 6:17138 (DOE/DP/40013—1)
DOSE COMMITMENTS
Comparative Evaluations
Comparison of 50-year and 70-year internal-dose-conversion factors, 6:17744 (ORNL/TM—7415)
DOSEMETERS
See also ALBEDO-NEUTRON DOSEMETERS
Recommendations
Personnel dosimetry calibrations, 6:17506 (PNL—3700(Pt.5))
DOUBLET 3 DEVICES
See DOUBLET REACTORS
DOUBLET REACTORS
Research Programs
Magnetic fusion energy program. Summary progress report, October 1, 1978-September 30, 1979, 6:17837 (GA-A—16098)
DRIFT CHAMBERS
Charge Collection
Drift and proportional tracking chambers, 6:17316 (SLAC—239)
Electron Drift
Drift and proportional tracking chambers, 6:17316 (SLAC—239)
Particle identification by energy loss measurement and long drift imaging chambers, 6:17317 (SLAC—239)
Particle Identification
Particle identification by energy loss measurement and long drift imaging chambers, 6:17317 (SLAC—239)
Reviews
Particle identification by energy loss measurement and long drift imaging chambers, 6:17317 (SLAC—239)
Spatial Resolution
Drift and proportional tracking chambers, 6:17316 (SLAC—239)
DRIFT INSTABILITY
Current-driven resistive drift instabilities in sheared magnetic fields, 6:17821
DRILL BITS
Bonding
Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
Design
Recent developments in polycrystalline diamond-drill-bit design, 6:16754 (SAND—79-1592C)
Fabrication
Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
Failures
Analysis of failed Stratapax-steel stud cutter elements, 6:16756 (SAND—80-0410)
Lubricants
Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits, 6:16757 (SAND—80-7136)
Materials Testing
Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits, 6:16757 (SAND—80-7136)
Seals
Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits, 6:16757 (SAND—80-7136)
DRILL CORES
Chemical Composition
Trace-element geochemistry of gradient hole cuttings: Beowawe geothermal area, Nevada, 6:16734 (DOE/ID/12079—21)
DRILLING FLUIDS
Data Acquisition Systems
Geothermal drilling fluid testing system, 6:16755 (SAND—79-7117)
Test Facilities
Geothermal drilling fluid testing system, 6:16755 (SAND—79-7117)
DRILLING MUD
See DRILLING FLUIDS
DRILLING PLATFORMS
See OFFSHORE PLATFORMS
DROPLETS
Mathematical Models
Shape of a pendent liquid drop, 6:17903
DROSOPHILA
Biological Indicators
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
Mutation Frequency
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
DUAL ENERGY USE SYSTEMS
See DEUS
DUAL-PURPOSE POWER PLANTS
Operating policies, problems and experiences with the Helsinki energy supply system, 6:17050
Feedwater
Water quality control at Detroit Edison Central Heating, 6:16792
Steam Systems
Red-tagging safety procedure for a steam distribution system, 6:17233
DUOPLASMATRONS
Beam Extraction
Characteristics of a modified duoPIGatron negative ion source, 6:17583 (BNL—51304)
Performance
Characteristics of a modified duoPIGatron negative ion source, 6:17583 (BNL—51304)
DUSTS
Air Pollution Control
Measurement and control of respirable dust in mines, 6:16459 (NMAB—363)
Control
Reducing dust at longwall shearers by confining the dust cloud to the face, 6:16424 (BM-TPR—111)
Monitoring
Measurement and control of respirable dust in mines, 6:16459 (NMAB—363)
DYNAMIC FUNCTION STUDIES
Nuclear Magnetic Resonance
Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)
DYNAMIC STUDIES (BIOLOGICAL)
See DYNAMIC FUNCTION STUDIES
DYSPROSIUM 164 TARGET
Argon 40 Reactions
Nuclear research with heavy ions. Annual progress report. January 1, 1980-December 31, 1980, 6:17724 (DOE/ER/13246—20)

E

EARTH ATMOSPHERE
See also AIR
IONOSPHERE
STRATOSPHERE
Atmospheric Chemistry
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
Climates
General circulation experiment with a coupled atmosphere, ocean and sea ice model, 6:17347
EARTHMOVING EQUIPMENT
Technology Assessment
FUSRAP equipment concept development study, 6:17419 (CONF-791234—)

EARTHQUAKES
Forecasting
Rupture zones of great earthquakes in the Alaska-Aleutian arc, 1784 to 1980, 6:17551
Ground Motion
Swedish earthquakes and acceleration probabilities, 6:17549 (FOA-C—20295-E4)
Hypocenters
Evaluation of hypocenter location techniques with applications to southern Utah: regional earthquake distributions and seismicity of geothermal areas, 6:16733 (DOE/ET/28392—32)
EBR-2 REACTOR
Hot Cells
Post-irradiation handling and examination at the HFEF complex, 6:16856 (CONF-800592—9)
Remote Handling Equipment
Post-irradiation handling and examination at the HFEF complex, 6:16856 (CONF-800592—9)
ECCS
(Emergency core cooling system.)
See also CORE FLOODING SYSTEMS
Computer Graphics
Graphic display of spatially distributed binary-state experimental data (PWR; BWR), 6:16861 (CONF-810235—1)
Hydraulics
Graphic display of spatially distributed binary-state experimental data (PWR; BWR), 6:16861 (CONF-810235—1)
ECOLOGICAL COMMUNITIES
See ECOSYSTEMS
ECOLOGY
Population Dynamics
Evolution of mutualism between species, 6:17395 (CONF-800160—1)
ECOSYSTEMS
See also AQUATIC ECOSYSTEMS
TERRESTRIAL ECOSYSTEMS
Carbon Cycle
Consumer regulation of nutrient cycling, 6:17399
Mineral Cycling
Consumer regulation of nutrient cycling, 6:17399
Nitrogen Cycle
Consumer regulation of nutrient cycling, 6:17399
EDS LIQUEFACTION
See EXXON LIQUEFACTION PROCESS
EDUCATION
Meetings
Training of nuclear facility personnel, 6:16814 (CONF-810411—)
Regulations
Revision to ANSI/ANS 3.1 1978: resulting from TMI-2, 6:16847 (CONF-810411—)
EDUCATIONAL FACILITIES
See also SCHOOL BUILDINGS
District Heating
Hartford Steam Service Company: annual business report for 1979, 6:17052
ICES
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage I. Feasibility analysis. Final report. Volume 1, 6:17044 (DOE/CS/20068—4)
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage II. Preliminary design. Final report, 6:17045 (DOE/CS/20068—5)
Steam Generators
Operating experience of a coal-fired fluidized bed at Georgetown, University, 6:16958 (CONF-800483—(Vol.2))
Steam Systems
Hartford Steam Service Company: annual business report for 1979, 6:17052
EFFLUENTS (CHEMICAL)
See CHEMICAL EFFLUENTS
EGGS
Hatching
Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397
Ontogenesis
Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397
EHF RADIATION
See MICROWAVE RADIATION
EIIP
See ENERGY PARKS
ELECTRIC ARCS
Dynamics of vaporization and dissociation during transient surface heating, with application to vacuum arcs, 6:17800 (SAND—81-0116)
ELECTRIC BATTERIES
(Devices for production and/or storage of electrical energy from chemical reactions; excludes FUEL CELLS and RADIOISOTOPE BATTERIES.)
See also LEAD-ACID BATTERIES
Battery Charging
Electrochemically controlled charging circuit for storage batteries (Patent), 6:16883
Comparative Evaluations
Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
Data Compilation
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))
Life-Cycle Cost
Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
Manufacturers
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))
Research Programs
Chemical Process Research and Development Program, 6:16615 (LBL—11650)
Solar Battery Chargers
Solar energy for charging fork truck batteries, 6:16666 (CONF-800483—(Vol.2))
ELECTRIC CABLES
See also SUPERCONDUCTING CABLES
Electrical Insulation
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Effects of processing conditions on the reliability of cross-linked polyethylene cable insulation. Progress report, 6:17130 (DOE/ER/10421—T1)
Energy Analysis
Choosing power cables on the basis of energy economics, 6:17000 (CONF-800483—(Vol.2))
Fabrication
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Power Losses
Choosing power cables on the basis of energy economics, 6:17000 (CONF-800483—(Vol.2))
ELECTRIC CONDENSERS
See CAPACITORS
ELECTRIC CONDUCTIVITY
Data Processing
IPINV: a two-dimensional dipole-dipole resistivity modeling and inversion program. User's guide and documentation for Rev. 1, 6:17547 (DOE/ID/12079—25)
ELECTRIC FIELDS
Biological Effects
Project resumes: biological effects from electric fields associated with high-voltage transmission lines, 6:17538 (CONF-801187—(Absts.))
Measuring Methods
Electric fields under power lines (supplement to 'an examination of electric fields under ehv (extra-high-voltage) overhead power transmission lines'). Final report, 6:16813 (PB—80-222474)
ELECTRIC GENERATORS
(Rotating generators only; excludes DIRECT ENERGY CONVERTERS.)
See also TURBOGENERATORS

Design
Induction machine (Patent), 6:16783
Operation
Generalized model for electric distribution systems, 6:16804 (CONF-810433—1)
Performance
Generalized model for electric distribution systems, 6:16804 (CONF-810433—1)

ELECTRIC MOTORS
Performance
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)

ELECTRIC POWER
See also HYDROELECTRIC POWER
Cost
Impact of coal cleaning on the cost of new coal-fired power generation. Final report (Comparison of 7 hypothetical power generation cases), 6:16447 (EPRI-CS—1622)
Master Metering
Energy savings attributable to switching from master metering to individual metering of electricity, 6:16956 (ANL/EES-TM—124)
Metering
Energy savings attributable to switching from master metering to individual metering of electricity, 6:16956 (ANL/EES-TM—124)
Planning
Electricity tommorrow. 1981 final report, summary, 6:16937
Prices
Automatic and discretionary adjustment procedures for electric utility rates. Volume II. Final report, 6:16935 (PB—80-208978)

ELECTRIC POWER INDUSTRY
Risk Assessment
Comparative health and safety assessment of alternative future electrical-generation systems, 6:17451 (CONF-800567—6)

ELECTRIC UTILITIES
Cogeneration
Case studies of industrial cogeneration in the US (Concerns of 11 utilities surveyed), 6:17007 (CONF-800483—(Vol.2))
Operating policies, problems and experiences with the Helsinki energy supply system, 6:17050
Energy Conservation
Electricity tommorrow. 1981 final report, summary, 6:16937
Fuel Adjustment Mechanisms
Automatic and discretionary adjustment procedures for electric utility rates. Volume II. Final report, 6:16935 (PB—80-208978)
Fuels
Pricing new energy inputs into electrical supply in Hawaii, 6:16932 (HNEI—80-07)
Off-Peak Energy Storage
Development of zinc-bromine batteries for utility energy storage. Interim report, September 1978-August 1979, 6:16788 (EPRI-EM—1717)
Planning
Electricity tommorrow. 1981 final report, summary, 6:16937
Rate Structure
Automatic and discretionary adjustment procedures for electric utility rates. Volume II. Final report, 6:16935 (PB—80-208978)
Electric utility rate design study: costs and benefits of load management to society, 6:16933 (NP—22593)
Pricing new energy inputs into electrical supply in Hawaii, 6:16932 (HNEI—80-07)
Steam Generation
Statistical committee report of industry statistics for 1979, 6:17038

ELECTRICAL INSULATION
Dielectric Properties
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Mechanical Properties
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Physical Radiation Effects
Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)

ELECTRICAL SURVEYS
See also RESISTIVITY SURVEYS
TELLURIC SURVEYS
I Codes
IPINV: a two-dimensional dipole-dipole resistivity modeling and inversion program. User's guide and documentation for Rev. 1, 6:17547 (DOE/ID/12079—25)

ELECTRIC-POWERED VEHICLES
Aluminium-Air Batteries
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
Capitalized Cost
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
Commercialization
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980, 6:17067 (DOE/CS—0130/4)
Demonstration Programs
Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980, 6:17067 (DOE/CS—0130/4)
Electric Batteries
DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments, 6:17065 (CONF-800523—4)
Energy Consumption
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
Impact Tests
FMVSS (Federal Motor Vehicle Safety Standard) 212/219/301 testing of electric vehicles - Electra Van 600, EVA Pacer. Final report, 6:17070 (PB—80-212020)
Iron-Nickel Batteries
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Lead-Acid Batteries
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
Electric and hybrid vehicles charge efficiency tests of ESB EV-106 lead-acid batteries, 6:17068 (DOE/CS/54209—T1)
Marketing Research
Fleet-Car Market PENetration Simulator: CPEN user's guide, 6:17064 (BNL—51286)
Mechanical Transmissions
Advanced continuously variable transmissions for electric and hybrid vehicles, 6:17069 (DOE/NASA/51044—17)
Nickel-Zinc Batteries
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
Operating Cost
Estimates of the cost and energy consumption of aluminum-air electric vehicles, 6:17071 (UCRL—84445)
Performance
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
Safety
FMVSS (Federal Motor Vehicle Safety Standard) 212/219/301 testing of electric vehicles - Electra Van 600, EVA Pacer. Final report, 6:17070 (PB—80-212020)
Solar Battery Chargers
Solar energy for charging fork truck batteries, 6:16666 (CONF-800483—(Vol.2))
Technology Assessment
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)

Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980, 6:17067 (DOE/CS—0130/4)

ELECTROCATALYSTS
Performance Testing
Stability of Kocite electrocatalysts in phosphoric acid fuels cells. Final report, 6:16952 (EPRI-EM—1711)

ELECTRODES
See also CATHODES
Electrochemical Corrosion
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Erosion
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Materials
Ceramic component for electrodes (Patent), 6:16944
Materials Testing
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)

ELECTROLYTES
Optimization
Electrolyte properties for photoelectrochemical cells with emphasis on the molecular adaptation of metallocenes: a review, 6:16663

ELECTROLYTIC CELLS
Operation
Zirconia fuel cells and electrolyzers, 6:16947 (BNL—29133)

ELECTROMAGNETIC RADIATION
See also GAMMA RADIATION
LASER RADIATION
MICROWAVE RADIATION
VISIBLE RADIATION
X RADIATION
Biological Effects
Nonionizing electromagnetic radiation safety: a program of coordinated federal activities related to biological effects of nonionizing electromagnetic radiation (0-300ghz), 6:17539 (PB—80-211212)
USSR report: life sciences. Effects of nonionizing electromagnetic radiation, No. 3, 6:17540 (JPRS—77393)

ELECTRON BEAM TARGETS
Design
High-gain, low-intensity ICF targets for a charged-particle beam fusion driver, 6:16587

ELECTRON BEAMS
Magnetic Fields
Reality and significance of the Aharonov-Bohm effect, 6:17756
Phase Shift
Reality and significance of the Aharonov-Bohm effect, 6:17756

ELECTRON GUNS
Beam Currents
Intense low-emittance-electron-gun development at PHERMEX, 6:17280 (LA-UR—81-783)
Beam Extraction
Intense low-emittance-electron-gun development at PHERMEX, 6:17280 (LA-UR—81-783)

ELECTRON NEUTRINOS
Mass
Neutrino mixing in a grand unified theory, 6:17654 (DOE/ER/01545—289)
Weak Interactions
Neutrinos and neutrino interactions, 6:17659 (SLAC—239)

ELECTRON SPECTROMETERS
Angular Distribution
Angle-resolved electron spectrometer with multidetection, 6:17330
Resolution
Angle-resolved electron spectrometer with multidetection, 6:17330

ELECTRON TUBES
See also GYROCONS
Seals
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)

ELECTRON-ATOM COLLISIONS
Inelastic Scattering
[Interaction of slow electrons with high-pressure gases (quasi-liquids): synthesis of our knowledge on slow electron-molecule interactions. Progress report for year ending May 31, 1981, 6:17601 (DOE/EV/04703—T1)
Ionization
Ionization of uranium atoms by electron impact, 6:17603
Total Cross Sections
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)

ELECTRON-BEAM-PUMPED LASERS
See FREE ELECTRON LASERS

ELECTRONIC EQUIPMENT
See also MICROWAVE EQUIPMENT
Encapsulation
Finite-element-method study of stresses on simulated electronic components encapsulated in polystyrene-bead foam, 6:17236 (BDX—613-2551)
Research Programs
Electronics Engineering Department. Quarterly report No. 3, 1980, 6:17238 (UCRL—50025-80-3)
Soldered Joints
Finite-element-method study of stresses on simulated electronic components encapsulated in polystyrene-bead foam, 6:17236 (BDX—613-2551)

ELECTRON-MOLECULE COLLISIONS
Dipole Moments
Scattering by a dipolar system: divergence of cross sections at the critical moment for a point dipole rotor, 6:17604
Electron Attachment
Production of negative ions under non-equilibrium conditions, 6:17570 (BNL—51304)
Inelastic Scattering
[Interaction of slow electrons with high-pressure gases (quasi-liquids): synthesis of our knowledge on slow electron-molecule interactions. Progress report for year ending May 31, 1981, 6:17601 (DOE/EV/04703—T1)
Momentum Transfer
Scattering by a dipolar system: divergence of cross sections at the critical moment for a point dipole rotor, 6:17604

ELECTRON-POSITRON INTERACTIONS
Annihilation
How to calculate the heavy-quark fragmentation function: an application of cut vertices, 6:17667
Mass Spectra
Bremsstrahlung process in electron positron colliding beams, 6:17651
Psi Resonances
Brief review of recent results from the crystal ball detector at SPEAR, 6:17633 (SLAC—239)

ELECTRONS
Energy Losses
Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)
Wave Functions
Fringing fields and criticisms of the Aharonov-Bohm effect, 6:17757

ELECTROSLAG WELDING
Basic study of heat flow in fusion welding. Progress report, March 1, 1980-February 28, 1981, 6:17088 (DOE/ER/04799—2)

ELEMENTS
See also METALS
SEMIMETALS
Measuring Methods
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
Tissue Distribution
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322

ELMO BUMPY TORUS
Electron Rings
Research support for plasma diagnostics on Elmo Bumpy Torus: investigation of diamagnetic diagnostics for the electron rings, 6:17770 (ORNL/Sub—7676/1)

EMBRYONIC CELLS
Sensitivity
Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding, 6:17473
EMBRYONIC DEVELOPMENT
See ONTOGENESIS
EMERGENCY CORE COOLING SYSTEM
See ECCS
EMULSIONS
Stability
Mechanism of oil bank formation, coalescence in porous media and emulsion stability. Annual report, June 1979-May 1980, 6:16480 (DOE/BC/10069—10)
END USE SECTOR
See COMMERCIAL SECTOR
INDUSTRY
ENERGY
See also GEOTHERMAL ENERGY
NUCLEAR ENERGY
SOLAR ENERGY
Legislation
Impact of energy and environmental legislation on industry: problems of regulatory cost assessment, 6:16893 (BNL—28956)
Research Programs
Exploratory energy research program at the University of Michigan. Progress report, 6:16902 (DOE/ER/10125—1)
ENERGY ACCOUNTING
Energy Responsibility Accounting: an energy-conservation tool for industrial facilities, 6:17021 (CONF-800483—(Vol.2))
ENERGY ANALYSIS
See also ENERGY ACCOUNTING
Energy data handbook (Damocles). Part I: definitions and instructions, 6:16892
Oak Ridge Associated Universities, Institute for Energy Analysis research report 1980, 6:16915 (ORAU/IEA—25(1980))
Computer Codes
Overview of validation procedures for building energy-analysis simulation codes, 6:16978 (SERI/TP—721-1133)
Research Programs
Energy Analysis Program, 6:16887 (LBL—11650)
Energy Analysis Program, FY 1980, 6:16888 (LBL—11972)
Energy efficiency studies: building energy performance standards for residential buildings, 6:16905 (LBL—11972)
Regional studies, 6:16904 (LBL—11972)
Technology assessments, 6:16889 (LBL—11972)
ENERGY AUDITS
Field-tested model of industrial energy-conservation assistance to small industries, 6:17024 (CONF-800483—(Vol.2))
Attitudes
Review of utility home-energy-audit programs, 6:16962 (DOE/TIC—11436)
Operation
Review of utility home-energy-audit programs, 6:16962 (DOE/TIC—11436)
ENERGY COMPLEXES
See ENERGY PARKS
ENERGY CONSERVATION
US industrial energy consumption and conservation: past and future perspectives, 6:17029 (CONF-800483—(Vol.2))
Bibliographies
Energy conservation: policies, programs, and general studies. 1964-1978 (citations from the NTIS data base). Report for 1964-78 (240 citations), 6:16908 (PB—80-813785)
Energy conservation: policies, programs, and general studies. 1979-July 1980 (citations from the ntis data base). Report for 1979-July 1980 (138 citations), 6:16909 (PB—80-813793)
Calculation Methods
Validation of thermal-energy-savings calculations in the SECP handbook. Final report, 6:16959 (DOE/EI/10416—1)
Economic Analysis
Field-tested model of industrial energy-conservation assistance to small industries, 6:17024 (CONF-800483—(Vol.2))
Education
Education and training promote energy conservation, 6:17055 (CONF-800483—(Vol.2))
Energy Models
Major models and data sources for residential and commercial sector energy conservation analysis. Final report, 6:16960 (DOE/PE/70044—T2)
Implementation
Implementation planning for industrial energy conservation: approach and methodology, 6:16987 (ANL/CNSV-TM—55)
Information
Commercial and industrial energy conservation programs in Illinois (Assistance of state government), 6:17023 (CONF-800483—(Vol.2))
Institutional Factors
Saving money through employee motivation and participation in energy conservation, 6:17022 (CONF-800483—(Vol.2))
Meetings
Industrial Energy Conservation Technology, 6:16988 (CONF-800483—(Vol.2))
Standards
Proposed residential building standards: draft environmental impact report, 6:16969 (P—700-80-013)
Training
Education and training promote energy conservation, 6:17055 (CONF-800483—(Vol.2))
ENERGY CONSUMPTION
US industrial energy consumption and conservation: past and future perspectives, 6:17029 (CONF-800483—(Vol.2))
Data Compilation
Energy balances of OECD countries, 1974/1978, 6:16938
ENERGY DEMAND
Data Compilation
Energy balances of OECD countries, 1974/1978, 6:16938
Economic Analysis
ETA-MACRO: a user's guide (Tool for integrating long-term energy supply/demand projections), 6:16886 (EPRI-EA—1724)
Energy Models
Input-output and energy demand models for the UK, 6:16891
Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912
Forecasting
Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
Regional Analysis
Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
ENERGY EFFICIENCY
Demonstration Programs
Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2))
Educational Tools
Use of a conversational computer program in operator training for improved energy efficiency, 6:17025 (CONF-800483—(Vol.2))
Evaluation
Approach to evaluating equipment-efficiency policies, 6:17027 (CONF-800483—(Vol.2))
Information
Energy technical assistance: industrial processes program, 6:17054 (CONF-800483—(Vol.2))
Marketing Research
Industrial-conservation-technology energy-savings monitoring system, 6:17030 (CONF-800483—(Vol.2))
Meetings
Industrial Energy Conservation Technology, 6:16988 (CONF-800483—(Vol.2))
Research Programs
Energy Analysis Program, FY 1980, 6:16888 (LBL—11972)
Energy efficiency studies: building energy performance standards for residential buildings, 6:16905 (LBL—11972)
Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2))
Standards
Approach to evaluating equipment-efficiency policies, 6:17027 (CONF-800483—(Vol.2))

Technology Utilization
Industrial-conservation-technology energy-savings monitoring system, 6:17030 (CONF-800483—(Vol.2))

ENERGY FACILITIES
Planning
Site Development Planning Handbook, 6:17424 (DOE/AD/06212—1)
Site Selection
Site Development Planning Handbook, 6:17424 (DOE/AD/06212—1)

ENERGY INTEGRATED INDUSTRIAL PARKS
See ENERGY PARKS

ENERGY MANAGEMENT
Energy Responsibility Accounting: an energy-conservation tool for industrial facilities, 6:17021 (CONF-800483—(Vol.2))
Education
Oklahoma Industrial Energy Management Program, 6:17053 (CONF-800483—(Vol.2))
Planning
Primary urban energy-management-planning methodology, 6:16884 (DOE/IR/05106—1)

ENERGY MANAGEMENT SYSTEMS
Plant energy-cost-optimization program (PECOP), 6:16991 (CONF-800483—(Vol.2))

ENERGY MODELS
Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
Energy data handbook (Damocles). Part I: definitions and instructions, 6:16892
ETA-MACRO: a user's guide (Tool for integrating long-term energy supply/demand projections), 6:16886 (EPRI-EA—1724)
Algorithms
Mathematical foundations of LEAP, 6:16890 (ORNL—5754)
Energy Conservation
Major models and data sources for residential and commercial sector energy conservation analysis. Final report, 6:16960 (DOE/PE/70044—T2)
Energy Demand
Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912
Input-Output Analysis
Input-output and energy demand models for the UK, 6:16891
Validation
Mathematical foundations of LEAP, 6:16890 (ORNL—5754)

ENERGY PARKS
Socio-Economic Factors
Assessment of energy parks vs. dispersed electric power generating facilities. Final report, 15 July 1975-31 December 1976, 6:16936 (PB—80-214273)
Technology Assessment
Assessment of energy parks vs. dispersed electric power generating facilities. Final report, 15 July 1975-31 December 1976, 6:16936 (PB—80-214273)

ENERGY POLICY
See also NATIONAL ENERGY PLAN
Major models and data sources for residential and commercial sector energy conservation analysis. Final report, 6:16960 (DOE/PE/70044—T2)
Bibliographies
Energy conservation: policies, programs, and general studies. 1964-1978 (citations from the NTIS data base). Report for 1964-78 (240 citations), 6:16908 (PB—80-813785)
Energy conservation: policies, programs, and general studies. 1979-July 1980 (citations from the ntis data base). Report for 1979-July 1980 (138 citations), 6:16909 (PB—80-813793)
Recommendations
Oak Ridge Associated Universities, Institute for Energy Analysis research report 1980, 6:16915 (ORAU/IEA—25(1980))
Regional Analysis
Regional impacts, 6:17377 (PNL—3700(Pt.5))

ENERGY SOURCE DEVELOPMENT
Economic Impact
ETA-MACRO: a user's guide (Tool for integrating long-term energy supply/demand projections), 6:16886 (EPRI-EA—1724)
Energy Analysis
Technology assessments, 6:16889 (LBL—11972)
Energy Models
Energy data handbook (Damocles). Part I: definitions and instructions, 6:16892
Environmental Effects
Potential effects of energy related activities on the seasonal trajectories of epiphytic marine diatoms, 6:17463
Environmental Impacts
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Evaluation of the impact of Texas lignite development on Texas water resources. Technical completion report, 1 July 1976-30 September 1977, 6:16415 (PB—80-220635)
Evaluation of environmental issues on the use of peat as an energy source, 6:16417 (TR—80/031-001)
Regional studies, 6:16904 (LBL—11972)
Financing
Statement submitted by Roger W.A. Legassie, Assistant Secretary (acting) for Fossil Energy, to the Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, US Senate March 23, 1981, 6:16920 (DOE/FE—0014)
Regional Analysis
Regional studies, 6:16904 (LBL—11972)
Socio-Economic Factors
Regional studies, 6:16904 (LBL—11972)
Technology Assessment
ETA-MACRO: a user's guide (Tool for integrating long-term energy supply/demand projections), 6:16886 (EPRI-EA—1724)
Technology assessments, 6:16889 (LBL—11972)

ENERGY SOURCES
See also FOSSIL FUELS
NUCLEAR FUELS
RENEWABLE ENERGY SOURCES
WIND POWER
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)

ENERGY STORAGE
See also ANNUAL ENERGY STORAGE
COMPRESSED AIR ENERGY STORAGE
FLYWHEEL ENERGY STORAGE
Data Base Management
First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS), 6:16878 (CONF-791258—(Summ.))
Information Needs
Solar energy storage researchers information user study, 6:16726 (SERI/TR—751-793)

ENERGY SUPPLIES
Demonstration Programs
Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2))
Economic Analysis
ETA-MACRO: a user's guide (Tool for integrating long-term energy supply/demand projections), 6:16886 (EPRI-EA—1724)
Research Programs
Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2))

ENEWETAK
See ENIWETOK

ENGLAND
See UNITED KINGDOM

ENHANCED RECOVERY
See also CARBON DIOXIDE INJECTION
Demonstration Programs
Progress review No. 24: contracts for field projects and supporting research on enhanced oil recovery and improved drilling technology. Progress report, quarter ending September 30, 1980, 6:16481 (DOE/BETC—80/4)

Meetings
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)
Research Programs
Progress review No. 24: contracts for field projects and supporting research on enhanced oil recovery and improved drilling technology. Progress report, quarter ending September 30, 1980, 6:16481 (DOE/BETC—80/4)

ENIWETOK
Decontamination
Statistical aspects of the cleanup of Enewetak Atoll, 6:17409 (CONF-791234—)
Land Reclamation
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
Radioactivity
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)

ENRICHMENT (ISOTOPIC)
See ISOTOPE SEPARATION

ENVIRONMENT
Information Systems
Environmental data reporting system, 6:17446 (PNL—3700(Pt.5))

ENVIRONMENTAL TEMPERATURE
See AMBIENT TEMPERATURE

ENVIRONMENTAL TRANSPORT
See also RADIONUCLIDE MIGRATION
Computer Codes
AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)
Mathematical Models
Regional impacts, 6:17377 (PNL—3700(Pt.5))

ENZYME INHIBITORS
Chemical Preparation
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)
Specificity
Deoxyribonuclease I in mammalian tissues (Rats), 6:17472

EOR
See ENHANCED RECOVERY

EQUATIONS (DIFFERENTIAL)
See DIFFERENTIAL EQUATIONS

EQUILIBRIUM PLASMA
Omnigenous equilibria (Requirements for plasma confinement), 6:17799 (SAI—254-81-102-LJ)
Toroidal plasma equilibrium with gravity, 6:17808

EQUIPMENT
See also DISTILLATION EQUIPMENT
EARTHMOVING EQUIPMENT
HEAT RECOVERY EQUIPMENT
MINING EQUIPMENT
POLLUTION CONTROL EQUIPMENT
THERMAL ENERGY STORAGE EQUIPMENT
Energy Efficiency
Approach to evaluating equipment-efficiency policies, 6:17027 (CONF-800483—(Vol.2))

ERBIUM
Gettering
Pumping-speed-measurement techniques for getters, 6:17234 (GEPP-OP—563)

ERYTHROCYTES
Radionuclide Kinetics
In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs (Thesis), 6:17535 (UR—3490-1883)
Rheology
Rheology of suspensions of normal and hardened erythrocytes and their mixtures, 6:17504
Viscosity
Rheology of suspensions of normal and hardened erythrocytes and their mixtures, 6:17504

ESKIMOS
Sociology
Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)

ESTUARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS

ETA-1060 RESONANCES
Particle Identification
Upper limits on phiphi production in 350-GeV/c proton-beryllium collisions, 6:17643

ETHANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)

1,2-ETHANEDIOL
See GLYCOLS

ETHANOL
See also ETHANOL FUELS
Biosynthesis
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)
Demonstration Programs
Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)
Production
Energy balances in the production and end use of alcohols derived from biomass. A fuels-specific comparative analysis of alternate ethanol production cycles, 6:16648 (DOE/PE/70151—T5)
Ethanol: farm and fuel issues, 6:16653 (PB—80-215692)
Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)
Synthesis
Chemical Process Research and Development Program, 6:16615 (LBL—11650)
Uses
Energy balances in the production and end use of alcohols derived from biomass. A fuels-specific comparative analysis of alternate ethanol production cycles, 6:16648 (DOE/PE/70151—T5)

ETHANOL FUELS
Economic Impact
Ethanol: farm and fuel issues, 6:16653 (PB—80-215692)
Net Energy
Energy balances in the production and end use of alcohols derived from biomass. A fuels-specific comparative analysis of alternate ethanol production cycles, 6:16648 (DOE/PE/70151—T5)
Road Tests
Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)

ETHYLENE CARBOXYLIC ACID
See ACRYLIC ACID

ETHYLENE GLYCOL
See GLYCOLS

ETHYLENE POLYMERS
See POLYETHYLENES

EUPHORBIA
Biomass Plantations
Petroleum plantations for fuel and materials, 6:16665
Economics
Petroleum plantations for fuel and materials, 6:16665

EUROPEAN COMMUNITIES
Energy Models
Energy data handbook (Damocles). Part I: definitions and instructions, 6:16892
Energy Source Development
Energy data handbook (Damocles). Part I: definitions and instructions, 6:16892

EUROPIUM OXIDES
Neutron Diffraction
Temperature dependence of the spin dynamics of EuO, 6:17127
Spin Waves
Temperature dependence of the spin dynamics of EuO, 6:17127

EVACUATED TUBE COLLECTORS
Bonding
Bonding solar selective absorber foils to glass receiver tubes for use in evacuated tubular collectors: preliminary studies, 6:16712 (LA-UR—81-1023)

EXCAVATORS
See EARTHMOVING EQUIPMENT

EXHAUST GASES
Gas Analysis
Reference method 24-determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings. Reference method 25-determination of total gaseous nonmethane organic emissions as carbon. Background information for promulgated test methods. Final report, 6:17358 (PB—80-209778)
Toxicity
Potential health and environmental effects of diesel light duty vehicles, 6:17452 (LMF—82)
EXOTIC RESONANCES
See also ETA-1060 RESONANCES
Particle Production
Search for exotic meson production at 13 GeV/c in the reaction pi-n → p/sub (forward)/X--, 6:17648
EXPERIMENTAL BREEDER REACTOR-2
See EBR-2 REACTOR
EXXON DONOR SOLVENT LIQUEFACTION
See EXXON LIQUEFACTION PROCESS
EXXON GASIFICATION PROCESS
Engineering
Exxon catalytic coal-gasification process development program. Quarterly technical progress report, October-December 1979, 6:16350 (DOE/ET/13005—T2)
Mathematical Models
Exxon catalytic coal-gasification process development program. Quarterly technical progress report, October-December 1979, 6:16350 (DOE/ET/13005—T2)
Process Development Units
Exxon catalytic coal-gasification process development program. Quarterly technical progress report, October-December 1979, 6:16350 (DOE/ET/13005—T2)
EXXON LIQUEFACTION PROCESS
Pilot Plants
High-pressure slurry-letdown valve designs for Exxon Coal-Liquefaction Pilot Plant, 6:16359 (DOE/MC/14522—1)
Valves
High-pressure slurry-letdown valve designs for Exxon Coal-Liquefaction Pilot Plant, 6:16359 (DOE/MC/14522—1)
Selection and experience to date with block valves for the Exxon Coal-Liquefaction Pilot Plant, 6:16360 (DOE/MC/14522—1)

F

FARADAY GENERATORS
See MHD GENERATORS
FARMS
Water Heaters
Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
FAST FLUX TEST FACILITY REACTOR
See FFTF REACTOR
FAST NEUTRONS
Neutron Sources
Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD, 6:17692 (DOE/NDC—21/L(Vol.1))
FEDERAL REPUBLIC OF GERMANY
Energy Demand
Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912
FEED MATERIALS PLANTS
Solar Process Heat
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor Uranium Mill solar retrofit. Final technical report, 6:16701 (MDC-G—8656ES)
FEEDING
Daily Variations
Phenobarbital effects on weight gain and circadian cycling of food intake and body temperature, 6:17536
FEEDWATER
Quality Control
Water quality control at Detroit Edison Central Heating, 6:16792
Water Treatment
Water quality control at Detroit Edison Central Heating, 6:16792
FEMALES
Diet
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
FERMENTATION
See also ANAEROBIC DIGESTION
BIOCONVERSION
Economic Analysis
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Reviews
Biomass energy enhancement, 6:16649
Technology Assessment
Biomass energy enhancement, 6:16649
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
FERMILAB ACCELERATOR
Neutrino Beams
Recent results from the CFRR neutrino experiment at Fermilab, 6:17636 (SLAC—239)
Stochastic Cooling
Stochastic cooling of 200 MeV protons, 6:17260 (LBL—10757)
FERRATES
See IRON OXIDES
FFTF REACTOR
Fire Extinguishers
Fire protection at the Fast Flux Test Facility (a sodium cooled test reactor), 6:16857 (HEDL-SA—1985)
Fire Prevention
Fire protection at the Fast Flux Test Facility (a sodium cooled test reactor), 6:16857 (HEDL-SA—1985)
Gamma Spectra
Continuous gamma-ray spectrometry in the Fast Flux Test Facility, 6:16841 (HEDL-SA—2116)
Irradiation Procedures
Quality engineering in FFTF irradiation tests, 6:16842 (HEDL-SA—2200)
FIBER OPTICS
Connectors
Evaluation of fiber-optic connectors, 6:17213 (UCRL—53116)
FIBERGLASS
R Factors
Reduction in the thermal resistance (R-value) of loose-fill insulation and fiberglass batts due to compression, 6:16966 (ORNL/Sub—7715/2)
Thickness
Reduction in the thermal resistance (R-value) of loose-fill insulation and fiberglass batts due to compression, 6:16966 (ORNL/Sub—7715/2)
FIBROBLASTS
Growth
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486
Oncogenic Transformations
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486
FIELD-REVERSED MIRROR REACTORS
Design
Fusion component design for the moving-ring field-reversed mirror reactor, 6:17883 (UCID—18916)
Moving-ring field-reversed mirror reactor concept, 6:17877 (PPPL—1755)
Neutral beam sustained, field-reversed mirror reactors, 6:17876 (PPPL—1755)
FILTERS
Performance
Determination of protection factors for tandem HEPA filters, 6:17354 (LA-UR—81-729)
FINGERPRINTING (OIL SPILLS)
See OIL SPILLS

FINISHING (SURFACE)
See SURFACE FINISHING
FINLAND
District Heating
Operating policies, problems and experiences with the Helsinki energy supply system, 6:17050
Dual-Purpose Power Plants
Operating policies, problems and experiences with the Helsinki energy supply system, 6:17050
FIREDAMP
See METHANE
FIRST WALL
Aluminium
Design studies of an aluminum first wall for INTOR, 6:17828 (BNL—29190)
Materials Testing
Alloy development for irradiation performance in fusion reactors. Annual report, September 1979-September 1980, 6:17832 (DOE/ER/10107—1)
FISCHER-TROPSCH SYNTHESIS
Catalysts
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
Isotope Effects
Evidence for H_2/D_2 isotope effects on Fischer-Tropsch synthesis over supported ruthenium catalysts, 6:17181
Specificity
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
Yields
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
FISHES
Entrainment
Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)
Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station (Analysis of impacts of thermal discharge on Maumee Bay and analysis of impact of entrainment and impingement on fish communities), 6:17524 (PNL—3409)
Impingement
Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station (Analysis of impacts of thermal discharge on Maumee Bay and analysis of impact of entrainment and impingement on fish communities), 6:17524 (PNL—3409)
Population Dynamics
Fish community studies in the Patuxent estuary, 1978-79. Final report, April 1976-March 1979, 6:17523 (PB—80-209976)
FISHING INDUSTRY
Economic Impact
Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)
FISSION NEUTRONS
Multiplicity
Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu, 6:17733 (EPRI-NP—1763)
Fission reaction in high energy proton cascade, 6:17731 (DOE/NDC—21/L(Vol.1))
FISSION PRODUCTS
Mass Number
Fission reaction in high energy proton cascade, 6:17731 (DOE/NDC—21/L(Vol.1))
Radioactive Waste Disposal
FUSRAP equipment concept development study, 6:17419 (CONF-791234—)
FLAMES
Combustion Products
Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978, 6:17203 (PB—80-207970)
FLASKS
See CASKS
FLAT PLATE COLLECTORS
Bibliographies
Flat plate solar collector design and performance. 1970-July 1980 (citations from the Engineering Index data base). Report for 1970-July 1980 (256 citations), 6:16714 (PB—80-814122)
Flat plate solar collector design and performance. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980 (196 citations), 6:16715 (PB—80-814130)
Thermal Insulation
Evaluation of silicone foam for flat plate solar collector insulation, 6:16722
FLAVOR MODEL
Conservation Laws
Natural flavor conservation, 6:17670 (DOE/ER/01545—301)
FLOWMETERS
Calibration
Application of a vortex shedding flowmeter to the wide range measurement of high temperature gas flow, 6:16865 (CONF-810434—3)
Field Tests
Novel approach to field testing shunt-flow steam meters, 6:17039
Performance Testing
Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
FLUE GAS
Additives
Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers, 6:17004 (CONF-800483—(Vol.2))
Chemical Analysis
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Denitrification
NO/sub x/ control and recovery from products of combustion (Patent), 6:16802
Pessel-AEL flue-gas desulfurization process. Final report, 6:16404 (DOE/IR/06355—T1)
Desulfurization
Aqueous carbonate process test requirements document. Final report, 6:16407 (EPRI-CS—1738)
Construction materials for wet scrubbers. Volume 2. Final report, 6:16406 (EPRI-CS—1736(Vol.2))
Economics of four FGD systems. Final report, 6:16794 (EPRI-CS—1677)
Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report, 6:16405 (EPRI-CS—1579(Vol.3)(Add.))
Pessel-AEL flue-gas desulfurization process. Final report, 6:16404 (DOE/IR/06355—T1)
Scrubber-generated particulate: literature survey. Final report, 6:17352 (EPRI-CS—1739)
Monitoring
Oxygen and opacity stack-emission monitoring systems to optimize combustion efficiency and meet EPA requirements, 6:17005 (CONF-800483—(Vol.2))
Opacity
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
FLUIDIZED BED
Parametric Analysis
Effect of bed and jet parameters on vertical jet penetration length in gas fluidized beds, 6:17239 (CONF-801104—13)
FLUIDIZED-BED COMBUSTORS
Coal
Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2))
Heat Transfer
Heat transfer to tubes in freeboard space of fluidized bed combustors. Progress report, August 1, 1980-January 31, 1981, 6:17240 (DOE/PC/30214—T1)

Operation
Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978, 6:16798 (PB—80-219249)
Performance
Operating experience of a coal-fired fluidized bed at Georgetown, University, 6:16958 (CONF-800483—(Vol.2))
Performance Testing
Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978, 6:16798 (PB—80-219249)
Solid Wastes
Experimental/engineering support for EPA's FBC program: final report. Volume III. Solid residue study. Final report, January 1977-December 1978, 6:16799 (PB—80-219256)

FLUORESCENCE
Mathematical Models
[Fluorescent scattering by molecules embedded in small particles]. Comprehensive report, 1977-1980, 6:17600 (DOE/EV/04361—T2)

FLUORINE 18
Radioisotope Scanning
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)

FLUX CORED ARC WELDING
See ARC WELDING

FLUXOIDS
See MAGNETIC FLUX

FLY ASH
Control Systems
Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers, 6:17004 (CONF-800483—(Vol.2))

FLYWHEEL ENERGY STORAGE
Data Processing
First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS), 6:16878 (CONF-791258—(Summ.))

FLYWHEEL-POWERED VEHICLES
Data Processing
First DOE/LLL workshop on the DOE/STOR Technical Management Information System, (TMIS), 6:16878 (CONF-791258—(Summ.))

FLYWHEELS
Molding
Compression-molded energy-storage flywheels, 6:16879 (UCRL—15324)
Physical Properties
Compression-molded energy-storage flywheels, 6:16879 (UCRL—15324)

FOOD INDUSTRY
See also DAIRY INDUSTRY
Energy Efficiency
Practical procedures for auditing industrial boiler plants, 6:17002 (CONF-800483—(Vol.2))

FOOD PROCESSING
Energy Conservation
Thermal energy storage/heat recovery and energy conservation in food processing, 6:16989 (CONF-800483—(Vol.2))
Waste Heat Utilization
Thermal energy storage/heat recovery and energy conservation in food processing, 6:16989 (CONF-800483—(Vol.2))
Waste Water
Production of biogas from waste waters of food-processing industries, 6:16990 (CONF-800483—(Vol.2))
Wind Turbines
Economic analysis of wind-powered refrigeration cooling/water-heating systems in food processing. Final report, 6:16770 (DOE/SEA—1109-20401/81/1)

FORMALDEHYDE
Chemical Preparation
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
Indoor Air Pollution
Organic contaminants: a bibliography, 6:17356 (LBL—12199)

FOSSIL FUELS
See also COAL
NATURAL GAS
OIL SANDS
OIL SHALES
PEAT
PETROLEUM
SHALE OIL
Combustion
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Oxygen and opacity stack-emission monitoring systems to optimize combustion efficiency and meet EPA requirements, 6:17005 (CONF-800483—(Vol.2))
Government Policies
Statement submitted by Roger W.A. Legassie, Assistant Secretary (acting) for Fossil Energy, to the Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, US Senate March 23, 1981, 6:16920 (DOE/FE—0014)
Research Programs
Statement submitted by Roger W.A. Legassie, Assistant Secretary (acting) for Fossil Energy, to the Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, US Senate March 23, 1981, 6:16920 (DOE/FE—0014)

FOSSIL-FUEL POWER PLANTS
See also ELECTRIC UTILITIES
Boilers
Economic evaluation of losses to electric power utilities caused by ash fouling. Final technical report, November 1, 1979-April 30, 1980, 6:16793 (DOE/GFETC/10059—2)
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 1. Technical results. Final report, March 1977-May 1978, 6:16801 (PB—80-220957)
Review of new source performance standards for coal-fired utility boilers, phase three report, sensitivity studies for the selection of a revised standard. Final report, 6:16797 (PB—80-213036)
Commercialization
Approach to market-penetration analysis for advanced electric-power-generation technologies, 6:16926 (BNL—51285)
Environmental Impacts
Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978, 6:17384 (PB—80-205792)
Environmental assessment of a waste-to-energy process: Burlington Electric's wood and oil co-fired boiler, 6:16800 (PB—80-220627)
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)
Flue Gas
Economics of four FGD systems. Final report, 6:16794 (EPRI-CS—1677)
EPA utility FGD survey: January-March 1980. Quarterly report, 6:16796 (PB—80-211832)
NO/sub x/ control and recovery from products of combustion (Patent), 6:16802
Fluidized-Bed Combustors
Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978, 6:16798 (PB—80-219249)

Experimental/engineering support for EPA's FBC program: final report. Volume III. Solid residue study. Final report, January 1977-December 1978, 6:16799 (PB—80-219256)

Fuel Substitution

Powerplant and Industrial Fuel Use Act annual report, 6:16913 (DOE/RG—0057)

Gas Turbines

Means and method for the destruction of particles entrained in a gas stream (Patent), 6:16791

Hybrid Systems

Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)

Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)

Inventories

Inventory of power plants in the United States: December 1979, 6:16927 (DOE/EIA—0095(79))

Pollution Control Equipment

EPA utility FGD survey: January-March 1980. Quarterly report, 6:16796 (PB—80-211832)

Site Selection

Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)

Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)

Long-range regional power plant siting model. Proc. Paper 14322, 6:16803

Solar Repowering

Look to the future: solar repowering for tomorrow's energy needs, 6:16676 (CONF-800483—(Vol.2))

Solid Wastes

Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report, 6:16405 (EPRI-CS—1579(Vol.3)(Add.))

Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979, 6:16410 (PB—80-222409)

Technology Assessment

Approach to market-penetration analysis for advanced electric-power-generation technologies, 6:16926 (BNL—51285)

Waste Disposal

Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report, 6:16405 (EPRI-CS—1579(Vol.3)(Add.))

Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979, 6:16410 (PB—80-222409)

Waste Management

Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979, 6:16410 (PB—80-222409)

FOUNDATIONS

Testing

Full-scale load tests of experimental solar-collector foundations, 6:16718 (SAND—80-7076)

FOWL

Heat Recovery

Thermal energy storage/heat recovery and energy conservation in food processing, 6:16989 (CONF-800483—(Vol.2))

Processing

Thermal energy storage/heat recovery and energy conservation in food processing, 6:16989 (CONF-800483—(Vol.2))

FRACTURE MECHANICS

Finite Element Method

Development of a plastic fracture methodology. Final report, 6:16849 (EPRI-NP—1734)

FRANCE

Industry

Energy conservation in French industry and at Rhone-Poulenc, 6:17019 (CONF-800483—(Vol.2))

FRANCIUM 206

Beta-Plus Decay

Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730

Decay

High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report, 6:17723 (DOE/ER/10434—2)

Electron Capture

Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730

FRANCIUM 208

Beta-Plus Decay

Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730

Decay

High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report, 6:17723 (DOE/ER/10434—2)

Electron Capture

Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730

FRANCIUM 213

Nucleosynthesis

Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727

FRANCIUM 214

Nucleosynthesis

Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727

FREE ELECTRON LASERS

Feasibility Studies

Free electron laser experiment at the NSLS 700 MeV electron storage ring, 6:17291 (BNL—29209)

FREE RADICALS

See RADICALS

FRESH WATER ECOSYSTEMS

See AQUATIC ECOSYSTEMS

FRM DEVICES (THERMONUCLEAR)

See FIELD-REVERSED MIRROR REACTORS

FRUITS

(Edible parts of plants only.)

Fermentation

Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)

Uses

Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)

FTR REACTOR

See FFTF REACTOR

FUEL ADJUSTMENT MECHANISMS

Computer Calculations

Automatic and discretionary adjustment procedures for electric utility rates. Volume II. Final report, 6:16935 (PB—80-208978)

FUEL ASSEMBLIES

Deformation

Influence of core-assembly refueling requirements on LMFBR core-system design, 6:16839 (GEFR-SP—146)

Heat Transfer

Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)

Hydraulics
Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)
Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)
Performance Testing
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
Two-Phase Flow
Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)

FUEL CELL CATALYSTS
See ELECTROCATALYSTS

FUEL CELLS
See also ACID ELECTROLYTE FUEL CELLS
HIGH-TEMPERATURE FUEL CELLS
MOLTEN CARBONATE FUEL CELLS
REDOX FUEL CELLS
Bibliographies
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Fuel cells. 1979-June 1980 (citations from the NTIS data base). Report for 1979-June 1980 (139 citations), 6:16954 (PB—80-813397)

FUEL CONSUMPTION
Data Compilation
National emissions data system (NEDS) fuel use report (1977). Final report, 6:16924 (PB—80-212723)

FUEL COOLING INSTALLATIONS
See SPENT FUEL STORAGE

FUEL CYCLE
International Agreements
International cooperation in nuclear energy, 6:16907
Technology Assessment
Analysis of nuclear fuel cycles, 6:17459 (PNL—3700(Pt.5))

FUEL ECONOMY
Exhaust Gases
Evaluation of a Chrysler lean burn vehicle. Technical report, 6:17058 (PB—80-209927)

FUEL ELEMENTS
See also ANNULAR FUEL ELEMENTS
FUEL PINS
FUEL RODS
NUCLEAR FUELS
Chemical Properties
Fission-product source terms, 6:17380 (CONF-791234—)
Design
Nuclear reactor fuel element (Patent), 6:16851

FUEL GAS
See also HIGH BTU GAS
LOW BTU GAS
PRODUCER GAS
Calorific Value
Memphis demonstration plant program, 6:16344 (CONF-800878—2)
Molten Salt Coal Gasification Process Development Unit. Phase 2. Quarterly technical progress report No. 2, October-December 1980, 6:16348 (DOE/ET/10296—71)
Chemical Composition
Molten Salt Coal Gasification Process Development Unit. Phase 2. Quarterly technical progress report No. 2, October-December 1980, 6:16348 (DOE/ET/10296—71)
Cost
Memphis demonstration plant program, 6:16344 (CONF-800878—2)
Denitrification
Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes, 6:16375 (FE—2806-16)
Desulfurization
Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes, 6:16375 (FE—2806-16)
Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))
Section I: high-temperature desulfurization of fuel gases, 6:16376 (FE—2806-16)
Gas Chromatography
Molten Salt Coal Gasification Process Development Unit. Phase 2. Quarterly technical progress report No. 2, October-December 1980, 6:16348 (DOE/ET/10296—71)

FUEL LOADING
See REACTOR FUELING

FUEL OILS
See also HEATING OILS
RESIDUAL FUELS
Combustion
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)

FUEL PINS
Heaters
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
Performance Testing
Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, October 1-December 31, 1980, 6:16844 (LA—8742-PR)
Quality Assurance
Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, October 1-December 31, 1980, 6:16844 (LA—8742-PR)
Simulators
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)

FUEL REPROCESSING PLANTS
See also HEF
Remote Handling Equipment
Remotex and servomanipulator needs in nuclear fuel reprocessing plants, 6:16553 (CONF-810337—1)

FUEL RODS
Destructive Testing
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Nondestructive Testing
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Physical Radiation Effects
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Thermocouples
Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)

FUEL SLURRIES
Combustion
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
Demonstration Programs
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
Economics
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
Feasibility Studies
Pacific bulk commodity transportation system, executive summary. Final report, 6:16449 (PB—80-222565)
Pacific bulk commodity transportation system, Volume II. final report, 6:16450 (PB—80-222573)
Fuel Additives
Structure and stability of coal-oil mixtures and coal-water mixtures. Final report, 6:16455 (EPRI-CS—1695)
Rheology
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)
Stability
Coal-oil-mixture technology: a status report, 6:16452 (ANL/ECT-TM—3)

Structure and stability of coal-oil mixtures and coal-water mixtures. Final report, 6:16455 (EPRI-CS—1695)
Test Facilities
Coal-slurry test loop: development and operation, 6:16456 (NYSERDA—80-23)
Viscosity
Coal-slurry test loop: development and operation, 6:16456 (NYSERDA—80-23)

FUEL SUBSTITUTION
Legislation
Powerplant and Industrial Fuel Use Act annual report, 6:16913 (DOE/RG—0057)

FUELS
See also AUTOMOTIVE FUELS
FOSSIL FUELS
FUEL GAS
FUEL OILS
FUEL SLURRIES
GASOLINE
NUCLEAR FUELS
Prices
Regional variations in US residential-sector fuel prices: implications for development of building energy-performance standards, 6:16976 (PNL—3605)

FUMES
See AEROSOLS

FUNCTIONAL MODELS
Comparative Evaluations
Guidance for use of experimental systems to evaluate effects of stress in marine ecosystems, 6:17425 (ORNL/TM—7644)

FURNACES
See also GAS FURNACES
WOOD BURNING FURNACES
Design
Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2))
Fuel Economy
Slot Forge Furnace demonstration. Final report, 6:17034 (DOE/CS/40041—1)
Performance
Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2))
Testing
Slot Forge Furnace demonstration. Final report, 6:17034 (DOE/CS/40041—1)

FUSED SALTS
See MOLTEN SALTS

FUSION REACTORS
See THERMONUCLEAR REACTORS

FW-STOIC PROCESS
Start-Up
Coal gasification of a central heating plant (U. of Minnesota, Duluth campus; gas and oil firing), 6:16393

G

GADOLINIUM 157 TARGET
Fusion Reactions
Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)

GADOLINIUM 158 TARGET
Fusion Reactions
Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)

GADOLINIUM FLUORIDES
Specific Heat
Thermodynamics of the lanthanide trifluorides. IV. The heat capacities of gadolinium trifluoride GdF_3, lutetium trifluoride LuF_3, and yttrium trifluoride YF_3 from 5 to 350°K, 6:17149

GALLIUM 67
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)

GALLIUM 68
Positron Computed Tomography
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
Radiopharmaceuticals
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494

GALLIUM ALLOYS
Electric Conductivity
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Fabrication
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Magnetic Properties
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

GALLIUM ARSENIDE SOLAR CELLS
Evaluation
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Fabrication
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)

GALLIUM ARSENIDES
Crystal Growth
Growth of extremely uniform layers by rotating substrate holder with molecular beam epitaxy for applications to electro-optic and microwave devices, 6:17148
Electric Conductivity
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Optical Properties
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Sputtering
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)

GAMMA DETECTION
Comparative Evaluations
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Evaluation
High energy photon response, 6:17309 (PNL—3536)
Limiting Values
Statistical and low dose response, 6:17315 (PNL—3536)
Sensitivity Analysis
Statistical and low dose response, 6:17315 (PNL—3536)
Statistics
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Statistical and low dose response, 6:17315 (PNL—3536)

GAMMA RADIATION
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
Resonance Scattering
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322

GAS APPLIANCES
Condensates
Improvements in appliance efficiency. Task IV. Corrosive effects of condensate. Annual report for 1979, 6:16972 (PB—80-210735)
Design
Improvements in appliance efficiency. Task II. Improvement of commercial cooking equipment. Annual report for 1979, 6:16971 (PB—80-210727)

Energy Efficiency
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)
Improvements in appliance efficiency. Task II. Improvement of commercial cooking equipment. Annual report for 1979, 6:16971 (PB—80-210727)
Heat Recovery
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)
Technology Transfer
Foreign industry energy effectiveness. Final report for 1979, 6:17037 (PB—80-210743)

GAS BURNERS
Energy Efficiency
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)

GAS CENTRIFUGES
Mathematical Models
Calculation of the isotope distribution in a gas centrifuge, 6:16549 (K/CSD/TM—36)

GAS CHROMATOGRAPHY
Mass Spectroscopy
Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650)

GAS COOLANTS
See GASES

GAS COOLED FAST BREEDER REACTOR
See GCFR REACTOR

GAS COOLED FAST BREEDER REACTORS
See GCFR TYPE REACTORS

GAS ENGINES
See INTERNAL COMBUSTION ENGINES

GAS FURNACES
Energy Efficiency
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)
Heat Recovery
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)

GAS HYDRATES
Volcanic Gases
Possible terrestrial volcanic occurrences of gas clathrate hydrates, 6:17550

GAS LASERS
See also CARBON DIOXIDE LASERS
Feasibility Studies
Mercury—ammonia system at high mercury densities, 6:17222
Gas Flow
Fluid mechanics of fusion lasers. Final report, September 11, 1978-June 5, 1980, 6:17220 (DOE/DP/40070—1)

GAS OILS
Hydrogenation
Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

GAS SPILLS
Explosions
Experimental plan for 40-m³ liquefied natural gas (LNG) dispersion tests. 1981 tests, 6:16515 (UCID—18585(Suppl.1))
Field Tests
Experimental plan for 40-m³ liquefied natural gas (LNG) dispersion tests. 1981 tests, 6:16515 (UCID—18585(Suppl.1))
Research Programs
Recommended research on LNG safety, 6:16512 (DOE/EV/10024—1)

GAS TUNGSTEN-ARC WELDING
Bibliographies
Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)

GAS TURBINES
Means and method for the destruction of particles entrained in a gas stream (Patent), 6:16791
Design
High-reliability gas turbine combined-cycle development program: Phase I. Final report, 6:16786 (EPRI-AP—1681(Vol.1))
Materials Testing
Ceramic corrosion/erosion project description, 6:16368 (DOE/METC/SP—111)
Reliability
High-reliability gas turbine combined-cycle development program: Phase I. Final report, 6:16786 (EPRI-AP—1681(Vol.1))

GASEOUS WASTES
See also EXHAUST GASES
FLUE GAS
Air Pollution Control
Asphalt roofing manufacturing industry - background information for proposed standards. Final report, 6:17389 (PB—80-212111)
Standards
Asphalt roofing manufacturing industry - background information for proposed standards. Final report, 6:17389 (PB—80-212111)

GASES
See also AIR
DISSOLVED GASES
EXHAUST GASES
FLUE GAS
FUEL GAS
HIGH BTU GAS
LOW BTU GAS
NATURAL GAS
PRODUCER GAS
SYNTHESIS GAS
Cleaning
Means and method for the destruction of particles entrained in a gas stream (Patent), 6:16791
Measuring Instruments
Diagnostic system of the Lawrence Livermore National Laboratory two-stage light-gas gun, 6:17333
Microwave Spectra
Microwave spectrometer for the detection of transient gaseous species, 6:17331

GASIFICATION
See also COAL GASIFICATION
IN-SITU GASIFICATION
Data Base Management
Comparative analysis of peat gasification reactor configurations, 6:17906 (TR—80/031-001)

GASOLINE
Allocations
Motor gasoline allocation; adjustment and downward certification, 6:16922 (DOE/RG/10333—T1)

GCFR REACTOR
Reactor Materials
Mechanical properties of type 316 stainless steel materials after irradiation at 515°C and 585°C, 6:16843 (HEDL-TME—81-4)
Shielding
Final analysis of the GCFR radial blanket and shield integral experiment, 6:16846 (ORNL—5756)
Gas-cooled fast breeder reactor. Quarterly progress report, February 1, 1979-April 30, 1979, 6:16838 (GA-A—15406(add.))

GCFR TYPE REACTORS
Fuel Pins
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
Loss of Coolant
Application of a vortex shedding flowmeter to the wide range measurement of high temperature gas flow, 6:16865 (CONF-810434—3)

GELS
Crystal Structure
Liquefied natural gas gels: structure, rheology, and production energy requirements. Final report, January 1976-December 1979, 6:16521 (PB—80-210685)

Rheology
Liquefied natural gas gels: structure, rheology, and production energy requirements. Final report, January 1976-December 1979, 6:16521 (PB—80-210685)

GENE MUTATIONS
Genetic Mapping
Genetic and physical mapping in the early region of bacteriophage T7 DNA, 6:17488

GENERATORS (AEROSOL)
See AEROSOL GENERATORS

GENERATORS (ELECTRIC)
See ELECTRIC GENERATORS

GENERATORS (RADIOISOTOPE)
See RADIOISOTOPE GENERATORS

GENERATORS (STEAM)
See STEAM GENERATORS

GENES
Evaluation
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486

GEOLOGIC FAULTS
Detection
More mines make use of satellite imagery as a roof control tool, 6:16441
Remote Sensing
More mines make use of satellite imagery as a roof control tool, 6:16441

GEOPRESSURED SYSTEMS
Exploratory Wells
Geopressured geothermal drilling and completions technology development needs, 6:16743 (SAND—81-0021)
Resource Development
Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)

GEORGIA
Water Resources
Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina, 6:16622 (FERC—0075)
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)

GEOTHERMAL DISTRICT HEATING
Design
Boise geothermal heating, 1892-1982. Part II. Technical planning, 6:16760
Economic Analysis
Boise geothermal heating, 1892-1982. Part II. Technical planning, 6:16760
Institutional Factors
Boise geothermal district heating, 1892-1982. Part I. Institutional planning, 6:16759
Marketing Research
Feasibility of a geothermal district heating scheme, 6:16761

GEOTHERMAL ENERGY
Liquid Wastes
Geothermal liquid waste disposal, 6:17457 (PNL—3700(Pt.5))

GEOTHERMAL FIELDS
See also GEYSERS GEOTHERMAL FIELD
SALTON SEA GEOTHERMAL FIELD
Geothermal Power Plants
Commission decision on the Department of Water Resources' Application for Certification for the Bottle Rock Geothermal Project, 6:16746 (P—800-80-013)
Seismicity
Evaluation of hypocenter location techniques with applications to southern Utah: regional earthquake distributions and seismicity of geothermal areas, 6:16733 (DOE/ET/28392—32)

GEOTHERMAL FLUIDS
Thermodynamic Properties
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)

GEOTHERMAL POWER PLANTS
Certification
Commission decision on the Department of Water Resources' Application for Certification for the Bottle Rock Geothermal Project, 6:16746 (P—800-80-013)
Environmental Impacts
Sacramento Municipal Utility District Geothermal Power Plant, SMUDGEO No. 1. Final report, 6:16744 (P—700-81-002)
Legal Aspects
Commission decision on the Department of Water Resources' Application for Certification for the Bottle Rock Geothermal Project, 6:16746 (P—800-80-013)
Reviews
International developments in geothermal power, 6:16747

GEOTHERMAL SYSTEMS
See also GEOPRESSURED SYSTEMS
MAGMA SYSTEMS
Computer Codes
Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico, 6:16740 (NP—25335)
Geochemistry
Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico, 6:16740 (NP—25335)
Mathematical Models
Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico, 6:16740 (NP—25335)

GEOTHERMAL WELLS
Drilling Fluids
Geothermal drilling fluid testing system, 6:16755 (SAND—79-7117)
Hydraulic Fracturing
Geothermal fracture stimulation technology. Volume III. Geothermal fracture fluids, 6:16751 (DOE/AL/10563—T8(Vol.3))
Propping Agents
Geothermal fracture stimulation technology. Volume 1. Fracturing proppants and their properties, 6:16749 (DOE/AL/10563—T8(Vol.1))
Geothermal fracture stimulation technology. Volume II. High-temperature proppant testing, 6:16750 (DOE/AL/10563—T8(Vol.2))
Geothermal fracture stimulation technology. Volume IV. Proppant analysis at geothermal conditions, 6:16752 (DOE/AL/10563—T8(Vol.4))
Rock Drilling
Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits, 6:16757 (SAND—80-7136)
Testing
Well-bore effects in the analysis of two-phase geothermal well tests, 6:16753 (LBL—12220)
Two-Phase Flow
Well-bore effects in the analysis of two-phase geothermal well tests, 6:16753 (LBL—12220)
Well Completion
Geothermal drilling and completion technology development program plan, 6:16758 (SAND—81-0380)
Polymer-cement geothermal-well-completion materials. Final report, 6:16748 (BNL—51287)
Well Drilling
Geopressured geothermal drilling and completions technology development needs, 6:16743 (SAND—81-0021)
Geothermal drilling and completion technology development program plan, 6:16758 (SAND—81-0380)
Materials and seal systems for the improvement of unsealed and sealed geothermal rock bits, 6:16757 (SAND—80-7136)
Old Maid Flat geothermal exploratory hole No. 7A drilling and completion report, 6:16742 (NVO—230)
Well Logging
Old Maid Flat geothermal exploratory hole No. 7A drilling and completion report, 6:16742 (NVO—230)
Well Temperature
Old Maid Flat geothermal exploratory hole No. 7A drilling and completion report, 6:16742 (NVO—230)

GERMANIUM
Electric Conductivity
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Optical Properties
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
GERMANIUM COMPOUNDS
Superconductivity
Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb, 6:17749 (DOE/ER/10436—2)
GERMANY (FEDERAL REPUBLIC)
See FEDERAL REPUBLIC OF GERMANY
GETTERS
Performance
Pumping-speed-measurement techniques for getters, 6:17234 (GEPP-OP—563)
GEYSERS GEOTHERMAL FIELD
Air Pollution
Drainage flow over complex terrain, 6:17353 (LA-UR—80-3052)
Geothermal Power Plants
Sacramento Municipal Utility District Geothermal Power Plant, SMUDGEO No. 1. Final report, 6:16744 (P—700-81-002)
GLASS
Electrical Properties
Properties of glasses with high water content. Progress report, 1 March 1980-31 January 1981, 6:17123 (DOE/ER/10453—2)
Electronic Structure
Study of local atomic and electronic structure in glassy metallic alloys. Progress report, December 1, 1979-November 1, 1980, 6:17121 (DOE/ER/10382—2)
Fracture Properties
Applications of scanning electron microscopy to failure analysis in ceramics and glasses, 6:17125 (SAND—81-0063C)
Properties of glasses with high water content. Progress report, 1 March 1980-31 January 1981, 6:17123 (DOE/ER/10453—2)
Joining
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Physical Radiation Effects
New photographic technique for observing bulk laser damage, 6:17078 (UCRL—84843)
Production
Wet chemical method for the production of synthetic raw materials and homogeneous powders for physical-chemical studies, 6:17167 (IS-Trans—111)
Wettability
Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs (Surfactants - carboxymethylized oxyethylate, naphthenic acid betaine, alkylsulfonate), 6:16472 (CONF-8004140—)
GLAUBER'S SALT
See SODIUM SULFATES
GLIOBLASTOMAS
See NEOPLASMS
GLOW CURVE
Comparative Evaluations
Environmental effects on the Hanford Multipurpose Personnel Dosimeter, 6:17313 (PNL—3536)
GLUCOSE
Metabolism
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
Metabolic mapping of the brain's response to visual stimulation: studies in humans, 6:17515
Stoichiometry
Hydrogen formation in nearly stoichiometric amounts from glucose by a Rhodopseudomonas sphaeroides mutant, 6:17479
GLYCINE HISPIDA
Genetic Mapping
Sequence organization of the soybean genome, 6:17484
GLYCOLIPIDS
Metabolism
Threshold effects and cellular recognition. Progress report, 6:17489 (DOE/EV/10268—1)
Synthesis
Threshold effects and cellular recognition. Progress report, 6:17489 (DOE/EV/10268—1)
GLYCOLS
Biochemical Reaction Kinetics
Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding, 6:17473
Biological Effects
Thermal denaturation of chromatin and lysine copolymer-DNA complexes. Effects of ethylene glycol, 6:17480
GNOME EVENT
Decontamination
Site decontamination, 6:17408 (CONF-791234—)
GOLD 195
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
GOLD 197 TARGET
Argon 40 Reactions
Nuclear research with heavy ions. Annual progress report. January 1, 1980-December 31, 1980, 6:17724 (DOE/ER/13246—20)
Neutron Reactions
Helium generation cross sections for fast neutrons, 6:17707 (DOE/NDC—21/L(Vol.1))
GOLD COMPLEXES
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
GRAIN BOUNDARIES
Mathematical Models
Coincidence lattice model for the structure and energy of grain boundaries, 6:17747 (DOE/ER/05002—16)
Vacancies
Computer simulation study of the structure of vacancies in grain boundaries, 6:17090 (DOE/ER/05002—15)
GRANITES
Radionuclide Migration
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
Sorptive Properties
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
GRANULAR BED FILTERS
Performance Testing
Laboratory/bench-scale testing and evaluation of the A.P.T. Dry-Plate Scrubber. Fourth quarterly technical progress report, December 1, 1980-February 28, 1981, 6:16403 (DOE/ET/15492—T12)
GRAPHITE
Atom Collisions
Probing the helium-graphite interaction, 6:17607
Physical Radiation Effects
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
Sorptive Properties
Probing the helium-graphite interaction, 6:17607
GRAVITY SURVEYS
T Codes
Terrain correction program for gravity data: user's guide and documentation for Rev. 0), 6:17548 (DOE/ID/12079—26)
GREAT BRITAIN
See UNITED KINGDOM
GREAT LAKES REGION
See also ILLINOIS

INDIANA
MICHIGAN
MINNESOTA
OHIO
WISCONSIN

Interconnected Power Systems
Power pooling in the North Central Region, 6:16929 (FERC—0052)

Wind Power
Wind energy resource atlas. Volume 3. Great Lakes Region, 6:16768 (PNL—3195-WERA-3)

GREENHOUSES

Information
Illinois solar greenhouse compendium, 6:16702 (PB—80-222516)

Solar Space Heating
Illinois solar greenhouse compendium, 6:16702 (PB—80-222516)

GROUND DISPOSAL
See UNDERGROUND DISPOSAL

Technology Assessment
Geothermal liquid waste disposal, 6:17457 (PNL—3700(Pt.5))

GROUND SUBSIDENCE

Forecasting
Design optimization in underground coal systems. Volume VII. Prediction of mining subsidence and related parameters over longwall mining operations. Final technical report, 6:16411 (FE—1231-25)

GROUND WATER

Chemical Analysis
Groundwater quality near an underground coal gasification experiment (Hoe Creek I; chemical analysis of ground water before, during and up to 280 days after expt.), 6:16418

Contamination
Effects of underground coal mining on ground water in the eastern United States. Final report, September 1976-September 1979, 6:17436 (PB—80-216757)

Monitoring
Groundwater quality monitoring of western coal strip mining: preliminary designs for active mine sources of pollution, 6:16414 (PB—80-220502)

Radionuclide Migration
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)

Water Pollution
Groundwater quality near an underground coal gasification experiment (Hoe Creek I; chemical analysis of ground water before, during and up to 280 days after expt.), 6:16418

Water Quality
Groundwater quality monitoring of western coal strip mining: preliminary designs for active mine sources of pollution, 6:16414 (PB—80-220502)

GROUND-WATER RESERVES
See AQUIFERS

GROWTH

Biological Effects
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486

GROWTH HORMONE
See STH

GUANIDINES

Crystal Structure
Improved crystal and molecular structure of guanidinium hydrogen oxalate monhydrate, $C(NH_2)_3HC_2O_4.H_2O$, 6:17184

Molecular Structure
Improved crystal and molecular structure of guanidinium hydrogen oxalate monhydrate, $C(NH_2)_3HC_2O_4.H_2O$, 6:17184

GUATEMALA

Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)

GULF GENERAL ATOMIC FAST BREEDER REACTOR
See GCFR REACTOR

GULF STREAM

Nutrients
Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981, 6:17429 (DOE/EV/00639—22)

GYPSUM

Solubility
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)

Storage
Evaluation of Chiyoda Thoroughbred 121 FGD process and gypsum stacking. Volume 3. Addendum. Final report, 6:16405 (EPRI-CS—1579(Vol.3)(Add.))

GYROCONS

Beam Dynamics
Status of the Los Alamos gyrocon, 6:17279 (LA-UR—81-772)

Performance
Status of the Los Alamos gyrocon, 6:17279 (LA-UR—81-772)

H

HADRON-HADRON INTERACTIONS

Higgs Bosons
Way to observe the Higgs boson H^0 in hadronic interactions, 6:17627 (BNL—29072)

HADRONIC PARTICLE DECAY

Quantum Chromodynamics
QCD corrections to quarkonia decays, 6:17652 (ANL-HEP-CP—80-60)

HALIDES
See also IODIDES

Crystal Structure
CO_2 laser absorption and saturation studies of molecular impurities in alkali halide crystals, 6:17138 (DOE/DP/40013—1)

HALL GENERATORS
See MHD GENERATORS

HALOGENATED ALIPHATIC HYDROCARBONS
See also BROMINATED ALIPHATIC HYDROCARBONS

Thermal Diffusion
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)

HALOGENATED AROMATIC HYDROCARBONS

Electron-Molecule Collisions
[Interaction of slow electrons with high-pressure gases (quasi-liquids): synthesis of our knowledge on slow electron-molecule interactions. Progress report for year ending May 31, 1981, 6:17601 (DOE/EV/04703—T1)

HANFORD RESERVATION

Contamination
Surface soil contamination standards for Rockwell Hanford Operations, 6:17412 (CONF-791234—)

Decontamination
Soil surface decontamination and revegetation progress, 6:17413 (CONF-791234—)

Radiation Monitoring
In situ measurement experiences, 6:17406 (CONF-791234—)

HASTELLOY X

Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

HATCHING

Temperature Dependence
Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397

HAWAII

Electric Utilities
Pricing new energy inputs into electrical supply in Hawaii, 6:16932 (HNEI—80-07)

Hydroelectric Power
Hydroelectric power in Hawaii. A report on the statewide survey of potential hydroelectric sites, 6:16617 (DOE/R9/10031—T1)

HAZARDOUS MATERIALS
Environmental Transport
AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)
H-COAL PROCESS
Flowsheets
Valve requirements and experience in the H-coal liquefaction process, 6:16358 (DOE/MC/14522—1)
HD 8077
See NICKEL BASE ALLOYS
HD-556
See ALLOY-HD-556
HE-3 COUNTERS
Calibration
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Design
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Operation
Evaluate existing radiation fields, 6:17311 (PNL—3536)
HEALTH PHYSICS
See RADIATION PROTECTION
HEAT EXCHANGERS
See also HEAT PUMPS
Performance Testing
Test results and methods: residential air-to-air heat exchangers for maintaining indoor air quality and saving money, 6:16964 (LBL—12280)
HEAT PUMPS
See also CHEMICAL HEAT PUMPS
WATER SOURCE HEAT PUMPS
Design
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Economic Analysis
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Economics
Heatpumps in steam district heating, 6:17048
Low level heat recovery through heat pumps and vapor recompression, 6:17014 (CONF-800483—(Vol.2))
Financial Data
Low level heat recovery through heat pumps and vapor recompression, 6:17014 (CONF-800483—(Vol.2))
Performance
Heatpumps in steam district heating, 6:17048
Performance Testing
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Photovoltaic Power Supplies
Heat pumps and utility-interactive photovoltaic power systems, 6:16668 (DOE/ET/20279—120)
Solar Heat Engines
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Waste Heat Utilization
Evaluation of industrial heat pumps for effective low-temperature heat utilization, 6:17015 (CONF-800483—(Vol.2))
HEAT RECOVERY
Economics
Evaluation of industrial heat pumps for effective low-temperature heat utilization, 6:17015 (CONF-800483—(Vol.2))
Low level heat recovery through heat pumps and vapor recompression, 6:17014 (CONF-800483—(Vol.2))
HEAT RECOVERY EQUIPMENT
Fuel Economy
Improvements in appliance efficiency. Task I. Upgrading seasonal efficiency of gas-fired heating appliances. Annual report for 1979, 6:16970 (PB—80-210719)
HEAT TRANSFER FLUIDS
Corrosive Effects
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Physical Properties
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
HEATERS
Energy Efficiency
Ninety-two percent minimum heater efficiency by 1980, 6:17032 (CONF-800483—(Vol.2))
Fabrication
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
Quality Assurance
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
HEATING OILS
Allocations
Problems of minority fuel-oil dealers, 6:16894 (DOE/PE/70106—T5)
Retailers
Problems of minority fuel-oil dealers, 6:16894 (DOE/PE/70106—T5)
HEAVY ION REACTIONS
See also ARGON 40 REACTIONS
BERYLLIUM 9 REACTIONS
CARBON 12 REACTIONS
DEEP INELASTIC HEAVY ION REACTIONS
IRON 56 REACTIONS
KRYPTON 86 REACTIONS
LITHIUM 7 REACTIONS
NEON 20 REACTIONS
NICKEL 58 REACTIONS
NIOBIUM 93 REACTIONS
OXYGEN 16 REACTIONS
XENON 136 REACTIONS
Inelastic Scattering
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)
HEAVY NUCLEI
Neutron Reactions
Measurement of the angle-integrated secondary neutron spectra from interaction of 14 MeV neutrons with medium and heavy nuclei (17 elements Ti to Bi), 6:17712 (DOE/NDC—21/L(Vol.1))
Status of (n,2n) cross section measurements at Bruyeres-le-Chatel (Threshold to 15 MeV, 50 targets), 6:17718 (DOE/NDC—21/L(Vol.1))
HEF
Remote Handling Equipment
Remotex and servomanipulator needs in nuclear fuel reprocessing plants, 6:16553 (CONF-810337—1)
HELIOSTATS
Design
Collector subsystem for the 10 MW/sub e/ solar thermal central receiver pilot plant. Phase 1. Technical status report, Issue 5, 6:16677 (MCR—78-1325)
Overall plant design description for collector subsystem for the 10-MW/sub e/ solar-thermal central-receiver pilot plant. Phase 1, 6:16678 (MCR—79-1311)
Second generation heliostat development for solar central receiver systems detailed design report. Volume II. Appendices, 6:16683 (SAND—79-8194(Vol.2)(App.))
Manufacturing
Second generation heliostat development for solar central receiver systems detailed design report. Volume II. Appendices, 6:16683 (SAND—79-8194(Vol.2)(App.))
Performance Testing
Operating experience at the Central Receiver Test Facility (CRTF), 6:16717 (SAND—80-2504C)
Solar Reflectors
Method of making reflecting film reflector (Patent), 6:16723
HELIUM
Adsorption
Physical adsorption: rare gas atoms on solid surfaces. Progress report, June 1, 1980-May 31, 1981, 6:17596 (DOE/ER/10454—1)

Probing the helium-graphite interaction, 6:17607
Collisions
Probing the helium-graphite interaction, 6:17607
Diffusion
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
Excited States
Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)
Ion-Atom Collisions
Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)
Energy and angular distributions of electrons from fast He^+ /He collisions, 6:17623
Energy dependence of alignment in foil collision-excited n = 3 states of He I, 6:17605
Molecular effects in beam-foil collision-induced alignment of He I, 6:17606

HELIUM 3 TARGET
Deuteron Reactions
Observation of d-^{3}He fusion reactions in a tokamak plasma, 6:17688

HELIUM 4 TARGET
Photonuclear Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))

HELIUM IONS
Ion-Atom Collisions
Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)
Energy and angular distributions of electrons from fast He^+ + He collisions, 6:17623

HEPTANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)

HETEROCYCLIC COMPOUNDS
Meetings
Fourth symposium on macrocyclic compounds, 6:17177 (DOE/ER/10605—4)
Synthesis
Multiheteromacrocycles that complex metal ions. Fifth progress report, 1 May 1978-30 April 1979, 6:17178 (DOE/ER/70218—T2)

HEXADECANE
Phase Studies
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Viscosity
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)

HEXANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)

HEXENES
Cracking
Effect of H_2S on the hydrogenation and cracking of hexene over a CoMo catalyst, 6:16491
Hydrogenation
Effect of H_2S on the hydrogenation and cracking of hexene over a CoMo catalyst, 6:16491

HEXOSES
See also GLUCOSE
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

HFIR REACTOR
Reactor Operation
High flux isotope reactor quarterly report, April, May, and June of 1980, 6:16858 (ORNL/TM—7754)

HHIRF
(Holifield Heavy Ion Research Facility.)
Energy Resolution
Coupled operation of the Oak Ridge isochronous cyclotron and the 25 MV tandem, 6:17272 (CONF-810314—82)
Performance Testing
Coupled operation of the Oak Ridge isochronous cyclotron and the 25 MV tandem, 6:17272 (CONF-810314—82)

HIGGS BOSONS
Bremsstrahlung
Way to observe the Higgs boson H^0 in hadronic interactions, 6:17627 (BNL—29072)

HIGH BTU GAS
Biosynthesis
Peat biogasification, 6:16613 (TR—80/031-001)
Synthesis
Peat gasification: IGT work progress, 6:16607 (TR—80/031-001)
Peat gasification: Rockwell International process, 6:16611 (TR—80/031-001)

HIGH ENERGY PHYSICS
Projection Spark Chambers
High energy physics annual report, January 1, 1979-December 31, 1979, 6:17642 (UCR—34P107-263)
Time-of-Flight Method
Time-of-flight measurements, 6:17320 (SLAC—239)

HIGH EXPLOSIVES
See CHEMICAL EXPLOSIVES

HIGH FLUX ISOTOPE REACTOR
See HFIR REACTOR

HIGH SPIN STATES
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)

HIGH-BETA PLASMA
Transport Theory
Variational moment solutions to the Grad-Shafranov equation, 6:17772 (ORNL/TM—7616)

HIGH-FREQUENCY HEATING
See also ICR HEATING
Radio frequency current drive in fusioning plasma, 6:17761 (GA-A—16194)
Wave-driver options for low-aspect-ratio steady-state tokamak reactors, 6:17826 (ANL/FPP/TM—141)

HIGH-LEVEL RADIOACTIVE WASTES
Leaching
Application of SYNROC to high-level defense wastes, 6:16572 (UCRL—85032)

HIGH-TEMPERATURE FUEL CELLS
Design
High-temperature, solid oxide electrolyte fuel cell power generation system. Quarterly report, June 1, 1980-August 31, 1980, 6:16949 (DOE/ET/17089—T1)
Operation
Zirconia fuel cells and electrolyzers, 6:16947 (BNL—29133)
Performance Testing
High-temperature, solid oxide electrolyte fuel cell power generation system. Quarterly report, June 1, 1980-August 31, 1980, 6:16949 (DOE/ET/17089—T1)

HIGH-TEMPERATURE GAS-COOLED REACTOR
See HTGR TYPE REACTORS

HISTONES
Biochemical Reaction Kinetics
Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding, 6:17473

HK 40
See ALLOY-HK-40

HOG FUEL
See WOOD WASTES

HOLES
(Absence of electrons from otherwise filled electron bands; see also BLACK HOLES, CAVITIES, OPENINGS, BORE HOLES, and VOIDS.)
Inspection
Assessment of available small deep hole inspection methods, 6:17228 (RFP—3198)

HOLIFIELD HEAVY ION RESEARCH FACILITY
See HHIRF

HOLMIUM 165 TARGET
Iron 56 Reactions
Charge and mass exchange in ^{56}Fe-induced reactions (465 MeV), 6:17708 (INIS-mf—6088)
Neutron emission from the strongly damped reaction ^{165}Ho + ^{56}Fe at 8.5 MeV, 6:17719 (INKA-Conf—79-001-000)
HOPPERS
Valves
Kamyr P-D Series Full-Borne Ball Valve METC SOA Test Valve No. A-17 state-of-the-art lockhopper valve-testing and development project, 6:16446 (DOE/METC/SP—125)
HORMONES
Acylation
Development and therapeutic application of internally emitting radiopharmaceuticals, 6:17197 (DOE/EV/04115—4)
HOT ATOM CHEMISTRY
(Chemical reactions of atoms or ions of high kinetic energies (more than 1 ev) resulting from nuclear transformations.)
Research Programs
Reactions of charged and neutral recoil particles following nuclear transformations. Final report, 6:17200 (ORO—3602-21)
HOT CELLS
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
HOT EXPERIMENT FACILITY
See HEF
HOT GAS CLEANUP
Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))
HOT WATER
Energy Systems
Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2))
HOUSES
Energy Audits
Review of utility home-energy-audit programs, 6:16962 (DOE/TIC—11436)
Photovoltaic Power Supplies
Solar photovoltaic residence in Carlisle, Massachusetts, 6:16671 (DOE/ET/20279—129)
Solar Space Heating
Investigation of the potential application of solar energy to existing homes. Semi-annual technical progress report, 6:16709 (DOE/R5/10235—1)
HTGR TYPE REACTORS
Coated Fuel Particles
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
Design
HTGR process heat program: design and analysis. Final report, FY-80 (1170 MW(t)), 6:16835 (GA-A—16217)
Feasibility Studies
High-temperature gas-cooled reactor: reformer application study, 6:16834 (DOE/SF/02034—T10)
Fuel Assemblies
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
Primary Coolant Circuits
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)
Reactor Materials
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
HUDSON RIVER
Water Quality
Hudson River cleanup, 6:17427 (CONF-791234—)
HUMAN CELLS
See ANIMAL CELLS
HUMAN POPULATIONS
See also ESKIMOS
Health Hazards
Potential health and environmental effects of diesel light duty vehicles, 6:17452 (LMF—82)
Quality of Life
Marshall Islands: a study of diet and living patterns, 6:17542 (BNL—51313)
Radiation Doses
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
HUNGARY
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)
HURRICANES
Water Waves
Moving boundary storm surge modelling with numerical methods (Water-land interface), 6:17431 (ORNL—5611)
HVAC SYSTEMS
Power Transmission Lines
Electric fields under power lines (supplement to 'an examination of electric fields under ehv (extra-high-voltage) overhead power transmission lines'). Final report, 6:16813 (PB—80-222474)
HVDC SYSTEMS
Research Programs
Assessment of research directions for high-voltage direct-current power systems. Quarterly technical progress report, July 1-September 30, 1980, 6:16806 (DOE/ET/29185—18)
Assessment of research directions for high voltage direct current power systems. Quarterly technical progress report, October 1, 1980-December 31, 1980, 6:16807 (DOE/ET/29185—19)
HYBRID ELECTRIC-POWERED VEHICLES
Commercialization
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980, 6:17067 (DOE/CS—0130/4)
Demonstration Programs
Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980, 6:17067 (DOE/CS—0130/4)
Iron-Nickel Batteries
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Lead-Acid Batteries
Electric and hybrid vehicles charge efficiency tests of ESB EV-106 lead-acid batteries, 6:17068 (DOE/CS/54209—T1)
Marketing Research
Fleet-Car Market PENetration Simulator: CPEN user's guide, 6:17064 (BNL—51286)
Mechanical Transmissions
Advanced continuously variable transmissions for electric and hybrid vehicles, 6:17069 (DOE/NASA/51044—17)
Performance
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
Technology Assessment
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Electric and Hybrid Vehicle Program. Fourth annual report to Congress for FY 1980, 6:17067 (DOE/CS—0130/4)
HYBRID REACTORS
Economic Analysis
Feasibility of recycling thorium in a fusion-fission hybrid/PWR symbiotic system, 6:17833 (DOE/ET/51010—9)

HYDRAULIC FRACTURING
Containment
Hydraulic-fracture propagation in layered rock: experimental studies of fracture containment, 6:16519 (SAND—80-2219C)
Laboratory investigation on the effect of in situ stresses on hydraulic fracture containment, 6:16520 (SAND—80-2307C)
HYDRAULIC MINING
Backfilling of cavities resulting from borehole mining, 6:16434
HYDROCARBONS
See also ALKENES
BENZENE
BENZOPYRENE
POLYCYCLIC AROMATIC HYDROCARBONS
POLYENES
STYRENE
TETRALIN
TOLUENE
Air Pollution Control
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)
Chemical Analysis
Micro-computer-based fuel-optimization system utilizing in-situ measurement of carbon monoxide, 6:17016 (CONF-800483—(Vol.2))
Chemical Reactions
Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O, 6:17618
Electric Conductivity
Electrostatic charge generation in hydrocarbon liquids. Final report, January 1978-August 1979, 6:16523 (PB—80-210768)
Solvent Properties
Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C, 6:17183
Synthesis
Liquid fuels production from biomass. Final report, 6:16605 (DOE/ET/20050—T4)
Toxicity
Low-Btu-gasifier emissions toxicology. Status report, June 1980, 6:17533 (LMF—77)
HYDRODYNAMICS
See also MAGNETOHYDRODYNAMICS
Computer Codes
Application program performance measurements, 6:17625 (UCRL—85677-VUGRAPH)
HYDROELECTRIC POWER
Economic Analysis
Hydroelectric power in Hawaii. A report on the statewide survey of potential hydroelectric sites, 6:16617 (DOE/R9/10031—T1)
Resource Potential
Hydroelectric power in Hawaii. A report on the statewide survey of potential hydroelectric sites, 6:16617 (DOE/R9/10031—T1)
HYDROELECTRIC POWER PLANTS
See also LOW-HEAD HYDROELECTRIC POWER PLANTS
Design
Water resources appraisal for hydroelectric licensing: Elwha River Basin, Washington. Appraisal report, 6:16619 (FERC—0072)
Economic Analysis
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)
Water resources appraisal for hydroelectric licensing: Elwha River Basin, Washington. Appraisal report, 6:16619 (FERC—0072)
Environmental Impacts
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)
Feasibility Studies
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)
Water resources appraisal for hydroelectric licensing: Elwha River Basin, Washington. Appraisal report, 6:16619 (FERC—0072)
Inventories
Inventory of power plants in the United States: December 1979, 6:16927 (DOE/EIA—0095(79))
Licensing
Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina, 6:16622 (FERC—0075)
Planning status report. Water resources appraisals for hydroelectric licensing: Colorado River Basin, Texas, 6:16626 (FERC—0079)
Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report, 6:16620 (FERC—0073)
Water resources appraisals for hydroelectric licensing: Tennessee River Basin, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, and Alabama. Planning status report, 6:16621 (FERC—0074)
Water resources appraisals for hydroelectric licensing: American River Basin, California. Planning status report, 6:16623 (FERC—0076)
Water resources appraisals for hydroelectric licensing: Tombigbee-Warrior River Basin, Alabama and Mississippi. Planning status report, 6:16625 (FERC—0078)
Planning
Planning status report. Water resources appraisals for hydroelectric licensing: Colorado River Basin, Texas, 6:16626 (FERC—0079)
Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report, 6:16620 (FERC—0073)
Water resources appraisals for hydroelectric licensing: Cumberland River Basin, Kentucky and Tennessee. Planning status report, 6:16624 (FERC—0077)
HYDROELECTRICITY
See HYDROELECTRIC POWER
HYDROGEN
Atom-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Negative ion production by charge exchange of hydrogen clusters with a cesium vapor target-status report, 6:17587 (BNL—51304)
Atom-Molecule Collisions
Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer, 6:17611
Bibliographies
Hydrogen energy: a bibliography with abstracts. Quarterly update: October-December 1980 (312 references), 6:16596 (TAC-H—80-004)
Chemical Reactions
Mechanism of the H + O_3 reaction, 6:17155
Theoretical characterization of the potential energy curve for hydrogen atom addition to molecular oxygen, 6:17616
Chemisorption
Determination of metal crystallite size and morphology in supported nickel catalysts, 6:17172
Combustion
Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Diffusion
Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Electron-Molecule Collisions
Production of negative ions under non-equilibrium conditions, 6:17570 (BNL—51304)

Excited States
Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)
Ion-Molecule Collisions
Production and destruction of H^- and D^- ions in hydrogen or deuterium plasmas, 6:17568 (BNL—51304)
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
Scattering
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
Solubility
Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Stoichiometry
Hydrogen formation in nearly stoichiometric amounts from glucose by a Rhodopseudomonas sphaeroides mutant, 6:17479

HYDROGEN 1 MINUS BEAMS
Beam Neutralization
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
Ion Density
Measurement of H^- and D^- density in plasma by photodetachment, 6:17574 (BNL—51304)
Meetings
Proceedings of the second international symposium on the production and neutralization of negative hydrogen ions and beams, 6:17567 (BNL—51304)
Photon-Ion Collisions
Measurement of H^- and D^- density in plasma by photodetachment, 6:17574 (BNL—51304)
Stripping
Neutralization of H^- beams by magnetic stripping, 6:17209 (LA-UR—81-831)

HYDROGEN 1 TARGET
Proton Reactions
Single and double pion production from 800 MeV proton-proton collisions, 6:17644

HYDROGEN 2
See DEUTERIUM

HYDROGEN 3
See TRITIUM

HYDROGEN COMPOUNDS
Configuration Interaction
Theoretical characterization of the potential energy curve for hydrogen atom addition to molecular oxygen, 6:17616

HYDROGEN IONS
See also HYDROGEN IONS 1 MINUS
HYDROGEN IONS 1 PLUS
Ion-Atom Collisions
Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)

HYDROGEN IONS 1 MINUS
Beam Production
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)
Ion Sources
Negative ion production by charge exchange of hydrogen clusters with a cesium vapor target-status report, 6:17587 (BNL—51304)
Operation of the Fermilab H^- magnetron source, 6:17581 (BNL—51304)
Proposed electrode design for direct extraction of negative ion beams, 6:17582 (BNL—51304)
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
Some effects of surface-plasma mechanism for production of negative ions, 6:17580 (BNL—51304)
Ion-Atom Collisions
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
Ion-Molecule Collisions
Production and destruction of H^- and D^- ions in hydrogen or deuterium plasmas, 6:17568 (BNL—51304)
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
Penning Ion Sources
Characteristics of a modified duoPIGatron negative ion source, 6:17583 (BNL—51304)
Recombination
H^- and D^- production in plasma, 6:17575 (BNL—51304)
Surface Ionization
Low work function surface for improving the yield of negative hydrogen ions, 6:17578 (BNL—51304)
Some effects of surface-plasma mechanism for production of negative ions, 6:17580 (BNL—51304)

HYDROGEN IONS 1 PLUS
Collisions
Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304)
Ion-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
Theoretical investigations of the collision dynamics in H^- formation and destruction, 6:17571 (BNL—51304)

HYDROGEN MINUS 1 BEAMS
See HYDROGEN 1 MINUS BEAMS

HYDROGEN NITRATES
See NITRIC ACID

HYDROGEN PRODUCTION
See also THERMOCHEMICAL PROCESSES
Synthetic fuels from laser fusion, 6:16588
Bibliographies
Hydrogen production. 1977-July 1980 (citations from the International Aerospace Abstracts data base). Report for 1977-July 1980, 6:16595 (PB—80-813553)
Biophotolysis
Photosynthetic water splitting, 6:16593 (CONF-810345—1)
Catalysis
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
Cost
Hydrogen production from small hyropower sites. Final report, 6:16592 (BNL—51309)
Electrolysis
Hydrogen production from small hyropower sites. Final report, 6:16592 (BNL—51309)
Thermochemical hydrogen production. Annual report for 1979, 6:16594 (PB—80-210776)
Thermochemical Processes
Thermochemical hydrogen production. Annual report for 1979, 6:16594 (PB—80-210776)
Thermochemical cyclic system for decomposing H_2O and/or CO_2 by means of cerium-titanium-sodium-oxygen compounds, 6:16597

HYDROGEN STORAGE
Iron Hydrides
Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
Modeling solid hydrogen storage beds, 6:16601 (ORNL/TM—7561)
Mathematical Models
Modeling solid hydrogen storage beds, 6:16601 (ORNL/TM—7561)
Titanium Hydrides
Determining the solubility and diffusivity of hydrogen and deuterium in the iron-titanium mixed crystal phase by resistance measurements, 6:16600 (JUEL—1648)
Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
Modeling solid hydrogen storage beds, 6:16601 (ORNL/TM—7561)
Underground Storage
Underground hydrogen storage. Final report (Salt caverns, excavated caverns, aquifers and depleted fields), 6:16598 (BNL—51275)

HYDROGEN SULFATES
See SULFURIC ACID
HYDROGEN SULFIDES
Chemical Reactions
Effect of H_2S on the hydrogenation and cracking of hexene over a CoMo catalyst, 6:16491
Photolysis
Reactions of HS radicals important in coal combustion. Project status report, January 1-March 31, 1981, 6:16454 (DOE/TIC—11441)
Removal
Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes, 6:16375 (FE—2806-16)
Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))
Section I: high-temperature desulfurization of fuel gases, 6:16376 (FE—2806-16)
Solubility
Solubilities of acid gases and nitrogen in methanol. Final report, September 1979-April 1980, 6:16616 (PB—80-212236)
Sorption
Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))
HYDROGENATION
Catalysts
Chemistry and morphology of coal liquefaction. Annual report, October 1, 1979-September 30, 1980, 6:16380 (LBL—12308)
HYDROLYSIS
Temperature Dependence
Influence of temperature on nonenzymatic hydrolysis of p-nitrophenyl phosphate in soil, 6:17396
HYDROMAGNETIC WAVES
Mathematical Models
Fluctuations in combustion-driven MHD generators, 6:16943 (DOE/ET/15611—1)

I

I-BEAM TYPE REACTORS
Feasibility Studies
Light ion fusion experiment (L.I.F.E.) concept validation studies. Final report, July 1979-May 1980, 6:17830 (DOE/DP/40109—2)
IBM COMPUTERS
Programming
Standards and procedures for INTERACT, 6:17892 (CONF-810431—1)
ICES
Design
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage II. Preliminary design. Final report, 6:17045 (DOE/CS/20068—5)
Feasibility Studies
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage I. Feasibility analysis. Final report. Volume 1, 6:17044 (DOE/CS/20068—4)
Institutional Factors
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage I. Feasibility analysis. Final report. Volume 1, 6:17044 (DOE/CS/20068—4)
Planning
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage II. Preliminary design. Final report, 6:17045 (DOE/CS/20068—5)
Systems Analysis
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage I. Feasibility analysis. Final report. Volume 1, 6:17044 (DOE/CS/20068—4)
ICR HEATING
Fast-wave ion-cyclotron heating in the Princeton Large Torus, 6:17774 (PPPL—1729)
IDAHO
Stratigraphy
Review of the upper Cenozoic stratigraphy overlying the Columbia River Basalt Group in western Idaho, 6:17545 (RHO-BWI-C—87)
IDAHO NATIONAL ENGINEERING LABORATORY
Decommissioning
Idaho National Engineering Laboratory decontamination and decommissioning summary, 6:17417 (CONF-791234—)
Decontamination
Idaho National Engineering Laboratory decontamination and decommissioning summary, 6:17417 (CONF-791234—)
ILLINOIS
Commercial Sector
Commercial and industrial energy conservation programs in Illinois (Assistance of state government), 6:17023 (CONF-800483—(Vol.2))
Geological Surveys
Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 1. Summary report. Final report, 1974-76, 6:16432 (PB—80-219454)
Industry
Commercial and industrial energy conservation programs in Illinois (Assistance of state government), 6:17023 (CONF-800483—(Vol.2))
Magnetic Surveys
Aerial gamma ray and magnetic survey, Indianapolis quadrangle, Indiana and Illinois. Final report, 6:16547 (GJBX—97(81))
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
Radiometric Surveys
Aerial gamma ray and magnetic survey, Indianapolis quadrangle, Indiana and Illinois. Final report, 6:16547 (GJBX—97(81))
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
IMAGE PROCESSING
Mosaic of coded aperture arrays (Patent), 6:17231
IMINOUREA
See GUANIDINES
IMMUNE SERA
See IMMUNE SERUMS
IMMUNE SERUMS
Genetic Effects
Immunoreactive helix-destabilizing protein localized in transcriptionally active regions of Drosophila polytene chromosomes, 6:17487
Metabolism
Immunoreactive helix-destabilizing protein localized in transcriptionally active regions of Drosophila polytene chromosomes, 6:17487
IMPACT SHOCK
Side Effects
Environmental effects on the Hanford Multipurpose Personnel Dosimeter, 6:17313 (PNL—3536)
INCINERATORS
Afterburners
Preliminary environmental assessment of afterburner combustion systems. Final report, March 1977-June 1980, 6:17245 (PB—80-215734)
Air Pollution
Environmental assessment of a waste-to-energy process: Braintree municipal incinerator, 6:17362 (PB—80-219421)
Field Tests
Environmental assessment of a waste-to-energy process: Braintree municipal incinerator, 6:17362 (PB—80-219421)
INCOLOY 800
Corrosion
Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)

Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)
Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

INCOLOY 802
Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

INCOMPRESSIBLE FLOW
Numerical Solution
Discrete-pressure equations in incompressible-flow problems, 6:17227 (KAPL—4139)
Pressure Gradients
Discrete-pressure equations in incompressible-flow problems, 6:17227 (KAPL—4139)

INCONEL 617
Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)

INDIA
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)
Meteorology
Marine boundary layer wind structure over the Bay of Bengal during MONEX79, 6:17342 (BNL—29260)

INDIANA
Magnetic Surveys
Aerial gamma ray and magnetic survey, Indianapolis quadrangle, Indiana and Illinois. Final report, 6:16547 (GJBX—97(81))
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))
Radiometric Surveys
Aerial gamma ray and magnetic survey, Indianapolis quadrangle, Indiana and Illinois. Final report, 6:16547 (GJBX—97(81))
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))

INDIUM 111
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)

INDIUM PHOSPHIDE SOLAR CELLS
Fabrication
Emerging material systems for solar-cell applications. Technical progress report No. 3, 17 October 1979-16 January 1980, 6:16641 (DOE/ET/23003—3)

INDIUM PHOSPHIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
Deposition
Emerging material systems for solar-cell applications. Technical progress report No. 3, 17 October 1979-16 January 1980, 6:16641 (DOE/ET/23003—3)

INDIUM SELENIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)

INDOOR AIR POLLUTION
Bibliographies
Organic contaminants: a bibliography, 6:17356 (LBL—12199)

INDUCTORS
See SOLENOIDS

INDUSTRIAL LAUNDRIES
See LAUNDRIES

INDUSTRIAL PLANTS
See also CHEMICAL PLANTS
COAL GASIFICATION PLANTS
COAL LIQUEFACTION PLANTS
FEED MATERIALS PLANTS
PETROCHEMICAL PLANTS
WASTE PROCESSING PLANTS
Air Pollution
Pollution caused by ammunition manufacturing. 1964-July 1980 (citations from the NTIS data base). Report for 1964-July 1980, 6:17376 (PB—80-814478)
Boilers
Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2))
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 2. Appendices. Final report, March 1977-May 1978, 6:17244 (PB—80-212939)
Practical procedures for auditing industrial boiler plants, 6:17002 (CONF-800483—(Vol.2))
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)
Burners
High-efficiency burners by retrofit: a simple inexpensive way to improve combustion efficiency, 6:16995 (CONF-800483—(Vol.2))
Cogeneration
Case studies of industrial cogeneration in the US, 6:17007 (CONF-800483—(Vol.2))
Cogeneration at a practical plant level, 6:16998 (CONF-800483—(Vol.2))
Cogeneration considerations in the 1980's, 6:17006 (CONF-800483—(Vol.2))
Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2))
Economics of steam/electric generation, 6:17008 (CONF-800483—(Vol.2))
Commodities
INCHEM Tokyo 79, 6:16897
Construction
Labor productivity in heavy construction: impact on synfuels program employment, 6:17447 (ANL/AA—24)
DEUS
Case studies of industrial cogeneration in the US, 6:17007 (CONF-800483—(Vol.2))
Electric Cables
Choosing power cables on the basis of energy economics, 6:17000 (CONF-800483—(Vol.2))
Energy Audits
Energy audits on Prince Edward Island (ENERSAVE program), 6:16994 (CONF-800483—(Vol.2))
Field-tested model of industrial energy-conservation assistance to small industries, 6:17024 (CONF-800483—(Vol.2))
Why energy audits aren't enough: an energy management system is required, 6:16992 (CONF-800483—(Vol.2))

Energy Conservation
Conservation: an in-plant energy resource, 6:17031 (CONF-800483—(Vol.2))
Field-tested model of industrial energy-conservation assistance to small industries, 6:17024 (CONF-800483—(Vol.2))
Industrial Energy Conservation Technology, 6:16988 (CONF-800483—(Vol.2))
US industrial energy consumption and conservation: past and future perspectives, 6:17029 (CONF-800483—(Vol.2))
Energy Consumption
US industrial energy consumption and conservation: past and future perspectives, 6:17029 (CONF-800483—(Vol.2))
Energy Efficiency
Approach to evaluating equipment-efficiency policies, 6:17027 (CONF-800483—(Vol.2))
Energy technical assistance: industrial processes program, 6:17054 (CONF-800483—(Vol.2))
Industrial-conservation-technology energy-savings monitoring system, 6:17030 (CONF-800483—(Vol.2))
Energy Management Systems
Plant energy-cost-optimization program (PECOP), 6:16991 (CONF-800483—(Vol.2))
Why energy audits aren't enough: an energy management system is required, 6:16992 (CONF-800483—(Vol.2))
Energy Recovery
Conservation: an in-plant energy resource, 6:17031 (CONF-800483—(Vol.2))
Equipment
Approach to evaluating equipment-efficiency policies, 6:17027 (CONF-800483—(Vol.2))
Fluidized-Bed Combustors
Economic evaluation of by-product power/cogeneration systems for industrial plants with fluidized-bed coal-burning facilities, 6:17009 (CONF-800483—(Vol.2))
Fuel Substitution
Powerplant and Industrial Fuel Use Act annual report, 6:16913 (DOE/RG—0057)
Pollution Control Equipment
Demonstration of carbon adsorption technology for petroleum dry cleaning plants. Final report, October 1977-April 1979, 6:16502 (PB—80-221039)
Power Plants
Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2))
Process Heat
Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2))
Rankine Cycle Power Systems
Cost-effective waste-heat Organic Rankine Cycle application and systems designs, 6:17013 (CONF-800483—(Vol.2))
Steam Systems
Analysis and development of large industrial steam systems, 6:16997 (CONF-800483—(Vol.2))
Waste Heat Utilization
Evaluation of industrial heat pumps for effective low-temperature heat utilization, 6:17015 (CONF-800483—(Vol.2))
Low level heat recovery through heat pumps and vapor recompression, 6:17014 (CONF-800483—(Vol.2))
Water Pollution
Pollution caused by ammunition manufacturing. 1964-July 1980 (citations from the NTIS data base). Report for 1964-July 1980, 6:17376 (PB—80-814478)

INDUSTRIAL SECTOR
See INDUSTRY

INDUSTRIAL WASTES
Waste Processing
Dewatering of industrial clay wastes, 6:17423 (BM-RI—8498)

INDUSTRY
See also CHEMICAL INDUSTRY
COAL INDUSTRY
ELECTRIC POWER INDUSTRY
FISHING INDUSTRY
FOOD INDUSTRY
LNG INDUSTRY
METAL INDUSTRY
NATURAL GAS INDUSTRY
OIL SAND INDUSTRY
OIL SHALE INDUSTRY
SOLAR INDUSTRY
SYNTHETIC FUELS INDUSTRY
TEXTILE INDUSTRY
Energy Conservation
Commercial and industrial energy conservation programs in Illinois (Assistance of state government), 6:17023 (CONF-800483—(Vol.2))
Energy conservation in French industry and at Rhone-Poulenc, 6:17019 (CONF-800483—(Vol.2))
Implementation planning for industrial energy conservation: approach and methodology, 6:16987 (ANL/CNSV-TM—55)
Industrial Energy Conservation Technology, 6:16988 (CONF-800483—(Vol.2))
Energy Demand
Impact of energy and environmental legislation on industry: problems of regulatory cost assessment, 6:16893 (BNL—28956)
Environmental Impacts
Impact of energy and environmental legislation on industry: problems of regulatory cost assessment, 6:16893 (BNL—28956)
Legislation
Impact of energy and environmental legislation on industry: problems of regulatory cost assessment, 6:16893 (BNL—28956)
Solar Process Heat
Solar production of industrial process steam. Phase III. Operation and evaluation of the Johnson and Johnson solar facility. Final report, January 1, 1980-March 31, 1981, 6:16694 (DOE/CS/31713—T1)
Value of thermal storage in solar IPH systems, 6:16706 (SERI/TR—731-905)
Technology Utilization
Impact of regulation on industrial innovation, 6:16896

INERTIAL CONFINEMENT
Power Supplies
Measurement of magnetically insulated line voltage using a Thomson Parabola Charged Particle Analyser, 6:17881 (SAND—80-2685C)

INHIBITORS (ENZYME)
See ENZYME INHIBITORS

INHOMOGENEOUS PLASMA
ICR Heating
ICRF oscillations of an inhomogeneous plasma cylinder, 6:17767 (LA-UR—81-682)

INJECTION WELLS
Evaluation
Apparatus and method for downhole injection of radioactive tracer (Patent), 6:17324
Modifications
Apparatus and method for downhole injection of radioactive tracer (Patent), 6:17324

INPUT-OUTPUT ANALYSIS
See ENERGY ANALYSIS

IN-SITU COMBUSTION
Bench-Scale Experiments
Estimation of oil recovery by in-situ combustion in the Jobo Field of Eastern Venezuela, 6:16485 (DOE/ET/12056—20)
Data Acquisition Systems
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Data Analysis
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Measuring Instruments
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)

IN-SITU GASIFICATION
Reverse combustion in a borehole, 6:16391
Borehole Linking
Applications of reservoir simulation to in situ coal gasification, 6:16386 (SAND—80-2579)
Instrumentation and process control development for in situ coal gasification, 6:16388 (SAND—80-2878)
Relative merits of alternate linking techniques for underground coal gasification and their system design implications, 6:16377

Data Acquisition Systems
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Data Analysis
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Environmental Effects
Groundwater quality near an underground coal gasification experiment (Hoe Creek I; chemical analysis of ground water before, during and up to 280 days after expt.), 6:16418
Measuring Instruments
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Process Control
Role of site characteristics in the control of underground coal gasification, 6:16387 (SAND—80-2664)
Reverse Combustion
Instrumentation and process control development for in situ coal gasification, 6:16388 (SAND—80-2878)
Site Selection
Role of site characteristics in the control of underground coal gasification, 6:16387 (SAND—80-2664)

IN-SITU RETORTING
Data Acquisition Systems
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Data Analysis
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)
Measuring Instruments
Instrumenting and evaluating large-scale in situ experiments, 6:16389 (SAND—81-0968C)

INSULATION (THERMAL)
See THERMAL INSULATION

INTEGRATED COMMUNITY ENERGY SYSTEMS
See ICES

INTERCONNECTED POWER SYSTEMS
Economics
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)
Electrical Transients
Design of multiprocessor structures for simulation of power-system dynamics. Final report, 6:16811 (EPRI-EL—1756)
Environmental Impacts
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)
Legal Aspects
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)
Load Analysis
Research on stochastic power-flow study methods. Final report, 6:16805 (DOE/ET/29102—1)
Operation
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)
Planning
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)
Regulations
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)
Reliability
Research on stochastic power-flow study methods. Final report, 6:16805 (DOE/ET/29102—1)
Stability
Design of multiprocessor structures for simulation of power-system dynamics. Final report, 6:16811 (EPRI-EL—1756)

INTERFEROMETERS
Design
Two-wavelength HeNe laser interferometer, 6:17801 (UCID—18988)

INTERFERON
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)

INTERMEDIATE MASS NUCLEI
Alpha Decay
Atomic masses for nuclides far from stability, 6:17716
Neutron Reactions
Differential scattering cross section measurements above 20 MeV, 6:17695 (DOE/NDC—21/L(Vol.1))
Helium generation cross sections for fast neutrons, 6:17707 (DOE/NDC—21/L(Vol.1))
Integral cross section measurements on (n,x) reactions induced by 30 MeV d(Be) break-up neutrons on FRT wall and structural materials, 6:17704 (DOE/NDC—21/L(Vol.2))
Measurement of the angle-integrated secondary neutron spectra from interaction of 14 MeV neutrons with medium and heavy nuclei (17 elements Ti to Bi), 6:17712 (DOE/NDC—21/L(Vol.1))
Status of (n,2n) cross section measurements at Bruyeres-le-Chatel (Threshold to 15 MeV, 50 targets), 6:17718 (DOE/NDC—21/L(Vol.1))

INTERMEDIATE TECHNOLOGY
See APPROPRIATE TECHNOLOGY

INTERMEDIATES (REACTION)
See REACTION INTERMEDIATES

INTERNAL COMBUSTION ENGINES
See also DIESEL ENGINES
Combustion
Technical progress report for application of numerical simulation methodology to automotive combustion, 6:17057 (DOE/ET/15397—T3)
Combustion Chambers
Effects of microwaves on the performance of internal-combustion engines. Final technical report, September 30, 1979-January 31, 1981, 6:17056 (DOE/ET/13116—T13)
Exhaust Gases
Evaluation of the Ethyl lean reactor system applied to a Dodge Coronet. Technical report, 6:17059 (PB—80-210305)
Pollution Control Equipment
Evaluation of the Ethyl lean reactor system applied to a Dodge Coronet. Technical report, 6:17059 (PB—80-210305)

INTESTINAL ABSORPTION
Tracer Techniques
Fecal ^{13}C analysis for the detection and quantitation of intestinal malabsorption, 6:17495

INTOR TOKAMAK
First Wall
Design studies of an aluminum first wall for INTOR, 6:17828 (BNL—29190)

INVERTERS
Energy Efficiency
Conservation theory process control using variable frequency drives, 6:17001 (CONF-800483—(Vol.2))
Process Control
Conservation theory process control using variable frequency drives, 6:17001 (CONF-800483—(Vol.2))
IODIDES
Density
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Hot Pressing
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Leaching
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Porosity
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Radioactive Waste Processing
Method for immobilizing radioactive iodine (Patent), 6:16574
IODINE
Energy Levels
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region (Petrovich-McManus-Madsen effective interaction), 6:17717
Radioactive Waste Processing
Method for immobilizing radioactive iodine (Patent), 6:16574
IODINE 112
Nuclear Structure
Recent experiments at the GSI on-line separator, 6:17709
IODINE 114
Nuclear Structure
Recent experiments at the GSI on-line separator, 6:17709
IODINE 115
Nucleosynthesis
Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727
IODINE 117
Nucleosynthesis
Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727
IODINE 118
Nucleosynthesis
Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727
IODINE 123
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
IODINE ISOTOPES
Chemical Preparation
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4)
Radioisotope Scanning
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)
Tissue Distribution
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4)
ION ACOUSTIC WAVES
Turbulence
Structure in the ion-acoustic spectrum, 6:17807
ION BEAM TARGETS
Design
High-gain, low-intensity ICF targets for a charged-particle beam fusion driver, 6:16587
ION BEAM TYPE REACTORS
See I-BEAM TYPE REACTORS
ION BEAMS
Beam Neutralization
Laser neutralization of negative ion beams for fusion, 6:17591 (BNL—51304)
Merits of D^--based neutral beam injectors for tokamaks, 6:17592 (BNL—51304)
Current Density
D^- ion accelerator immersed in a magnetic field, 6:17593 (BNL—51304)
ION COLLISIONS
See also ION-ATOM COLLISIONS
ION-MOLECULE COLLISIONS
PHOTON-ION COLLISIONS
Charge Exchange
Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304)
Research Programs
X-ray emission in heavy-ion collisions. Progress report, April 1, 1980-February 28, 1981 (Cyclotron Inst., Texas A and M Univ., College Station, 4/1/80-2/28/81), 6:17595 (DOE/ER/06036—1)
Secondary Emission
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)
ION CYCLOTRON-RESONANCE HEATING
See ICR HEATING
ION DENSITY
Measuring Methods
Measurement of H^- and D^- density in plasma by photodetachment, 6:17574 (BNL—51304)
ION SOURCES
See also DUOPLASMATRONS
PENNING ION SOURCES
Beam Extraction
Ion extraction and optics in three dimensions, 6:17838 (ORNL/TM—7691)
Proposed electrode design for direct extraction of negative ion beams, 6:17582 (BNL—51304)
Beam Optics
Ion extraction and optics in three dimensions, 6:17838 (ORNL/TM—7691)
Design
Development of multiampere negative ion sources, 6:17827 (BNL—29159)
LONGSHOT injector: a 3/4 kJ, 120 keV pulsed source of 3 x 10^{16} ions for ion ring formation, 6:17848 (PPPL—1755)
Performance
Operation of the Fermilab H^- magnetron source, 6:17581 (BNL—51304)
Surface Ionization
Some effects of surface-plasma mechanism for production of negative ions, 6:17580 (BNL—51304)
ION-ATOM COLLISIONS
Collision cross sections and equilibrium fractions of ions and atoms in metal vapor targets. Project progress report, June 1, 1979-May 31, 1980, 6:17760 (DOE/ET/53048—3)
Charge Exchange
Angular scattering in electron capture and loss D^- beam formation processes, 6:17572 (BNL—51304)
Cesium supersonic jet for D^- production by double electron capture, 6:17588 (BNL—51304)
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Production of D^- ions by double charge exchange of D^+ on cesium, 6:17586 (BNL—51304)
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
Theoretical investigations of the collision dynamics in H^- formation and destruction, 6:17571 (BNL—51304)
Cross Sections
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
IONIZATION CALORIMETERS
See SHOWER COUNTERS
ION-MOLECULE COLLISIONS
Charge Exchange
Production and destruction of H^- and D^- ions in hydrogen or deuterium plasmas, 6:17568 (BNL—51304)
Cross Sections
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
IONOSPHERE
Radiation Effects
Ionospheric modification by high-power radio waves, 6:17565 (LA-UR—81-870)

IOWA
Wind Power
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)
IRIDIUM
Neon 20 Reactions
Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730
IRIDIUM 191
Diagnostic Uses
Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4)
Toxicity
Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4)
IRON
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Corrosion
Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981, 6:17185 (DOE/ER/02960—T1)
Desulfurization
Kinetics of the desulfurization of molten iron. Final report, 6:17083 (DOE/CS/40153—T1)
Neutron Reactions
Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis (35 to 50 MeV), 6:17702 (DOE/NDC—21/L(Vol.1))
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Oxidation
Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report, 6:17097 (DOE/ET/10404—2)
Recycling
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)
Sulfidation
Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981, 6:17185 (DOE/ER/02960—T1)
IRON 54 TARGET
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
IRON 56
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
IRON 56 REACTIONS
Deep Inelastic Heavy Ion Reactions
Charge and mass exchange in ^{56}Fe-induced reactions (465 MeV), 6:17708 (INIS-mf—6088)
Neutron emission from the strongly damped reaction ^{165}Ho + ^{56}Fe at 8.5 MeV, 6:17719 (INKA-Conf—79-001-000)
Fusion Reactions
Neutron emission from the strongly damped reaction ^{165}Ho + ^{56}Fe at 8.5 MeV, 6:17719 (INKA-Conf—79-001-000)
IRON 56 TARGET
Iron 56 Reactions
Charge and mass exchange in ^{56}Fe-induced reactions (465 MeV), 6:17708 (INIS-mf—6088)
Neutron Reactions
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
IRON ALLOYS
See also IRON BASE ALLOYS
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Hydridation
Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981, 6:17094 (DOE/ER/10430—T1)
Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
Sorptive Properties
Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
IRON BASE ALLOYS
See also ALLOY-HK-40
STEELS
Brittle-Ductile Transitions
Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II, 6:17095 (DOE/ER/10433—2)
Crack Propagation
Atom-probe investigation of a micro-crack associated with hydrogen in a Fe-Ti alloy (Fe-0.29 wt % Ti), 6:17080 (CONF-800730—4)
Atomic-scale observation of hydrogen-induced crack growth by atom-probe FIM (Fe-0.29% Ti), 6:17092 (DOE/ER/10430—8)
Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
Grain Boundaries
Observation of grain boundary segregation on an atomic scale in a Fe-0.04% P alloy by atom-probe FIM, 6:17093 (DOE/ER/10430—9)
Hydridation
High-performance atom-probe field ion microscope study of segregation and hydrogen cracking in Fe-0.29 Ti, 6:17122 (DOE/ER/10430—7)
Precipitation
Study of precipitate morphology by consideration of elastic strain energy, 6:17103 (LBL—10639)
Segregation
Cluster formation and the elevated temperature strengthening of iron alloys by Ti, 6:17081 (CONF-800730—5)
Phosphorus segregation to grain boundaries in a Fe-0.04% P alloy (Fe-0.04% P), 6:17082 (CONF-800730—6)
Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
IRON COMPLEXES
Electronic Structure
Axial ligand effects on iron and manganese porphyrins: extended Hueckel calculations of Cyt P450 analogs and of O_2 binding to iron and manganese, 6:17162
IRON COMPOUNDS
Catalytic Effects
Existence of solitary traveling wave solutions of a model of the Belousov-Zhabotinskii reaction, 6:17175
IRON HYDROXIDES
Radiopharmaceuticals
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
IRON NITRIDES
Precipitation
Study of precipitate morphology by consideration of elastic strain energy, 6:17103 (LBL—10639)
IRON OXIDES
Crystal Defects
High-temperature properties and processes in ceramics: thermomigration. Annual report, January 1, 1980-December 31, 1980, 6:17119 (DOE/ER/02923—4)
Particle Size
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)

IRON-NICKEL BATTERIES
Performance
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments, 6:17065 (CONF-800523—4)
Electric and hybrid vehicle program. Quarterly report, October-November-December 1980, 6:17066 (DOE/CS—0026/13)
Technology Assessment
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)

IRRADIATION CAPSULES
Evaluation
Apparatus and method for downhole injection of radioactive tracer (Patent), 6:17324

IRRADIATION PLANTS
Design
Design criteria for dry-sludge irradiation demonstration plant (DSIDP), 6:16590 (SAND—81-7069)

IRRIGATION
Economics
Economics of wind energy for irrigation pumping, 6:16777 (DOE/SEA—7315-2074/81/2)
Solar Water Pumps
1980 annual report of the Coolidge Solar Irrigation Project, 6:16679 (SAND—80-2378)

ISABELLE STORAGE RINGS
Beam Bending Magnets
Mechanical properties of ISABELLE superconducting coils, 6:17295 (BNL—29236)
Study of factors which affect training in ISABELLE R and D magnets, 6:17287 (BNL—29194)
Beam Extraction
Design of fast kickers for the ISABELLE beam abort system, 6:17293 (BNL—29218)
Beam Focusing Magnets
Magnetic properties of ISABELLE superconducting quadrupoles, 6:17288 (BNL—29195)
Cavity Resonators
ISABELLE cavity gap assemblies, 6:17285 (BNL—29091)
Kicker Magnets
Design of fast kickers for the ISABELLE beam abort system, 6:17293 (BNL—29218)
Leak Detectors
Leak checking in ISABELLE, 6:17262 (BNL—29148)
Power Transmission Lines
ISABELLE superconducting power distribution system, 6:17290 (BNL—29197)
RF Systems
Beam - and drive - controlled amplifier for the ISABELLE accelerating system, 6:17289 (BNL—29196)
Superconducting Magnets
First cell magnet system tests, 6:17294 (BNL—29232)
ISABELLE magnet power supply system performance analysis, 6:17286 (BNL—29188)
ISABELLE superconducting power distribution system, 6:17290 (BNL—29197)
Mechanical properties of ISABELLE superconducting coils, 6:17295 (BNL—29236)
Upgraded coil configuration for ISABELLE magnets, 6:17297 (BNL—29307)
Vacuum Systems
ISABELLE cavity gap assemblies, 6:17285 (BNL—29091)
Leak checking in ISABELLE, 6:17262 (BNL—29148)
Outgassing rate of the copper-plated beam tube for ISABELLE, 6:17292 (BNL—29217)

ISCHEMIA
Death
Aggregation of deaths from ischaemic heart disease among first and second degree relatives of 108 males and 42 females with myocardial infarction, 6:17501

ISOBARS (NUCLEON)
*See N*RESONANCES*

ISOCHRONOUS CYCLOTRONS
Magnetic Field Configurations
Spiral design and beam dynamics for a variable energy cyclotron, 6:17251 (BNL—29201)

ISOMERIZATION
See CHEMICAL REACTIONS

ISOTOPE ENRICHMENT
See ISOTOPE SEPARATION

ISOTOPE RATIO
Correlations
Oxygen isotope ratios in trees reflect mean annual temperature and humidity, 6:17517
Mathematical Models
Oxygen isotope ratios in trees reflect mean annual temperature and humidity, 6:17517

ISOTOPE SEPARATION
(For separation of isotopes of the same element only.)
See also GAS CENTRIFUGES
LASER ISOTOPE SEPARATION
Mathematical Models
Generalized computer model of the transient behavior of multicomponent isotope-separation cascades, 6:16550 (MLM—2816(OP))
Technology Assessment
Technology assessment, 6:17453 (PNL—3700(Pt.5))

ISX TOKAMAK
Limiters
Testing of low-Z-coated limiters in tokamak fusion devices, 6:17831
Transport Theory
Variational moment solutions to the Grad-Shafranov equation, 6:17772 (ORNL/TM—7616)

J

JAPAN
Trade
INCHEM Tokyo 79, 6:16897

K

KANSAS
Geochemical Surveys
Hydrogeochemical and stream sediment reconnaissance basic data for Dodge City NTMS Quadrangle, Kansas, 6:16538 (GJBX—77(81))
Magnetic Surveys
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))
Radiometric Surveys
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)

KAOLIN
Density
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Hot Pressing
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Leaching
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Porosity
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)

KAON BEAMS
Accelerator Facilities
Prospects for pion and kaon factories, 6:17278 (LA-UR—81-746)
KAON-KAON INTERACTIONS
S Matrix
Solution of the unitarity equation with overlapping left and right cuts: a tool for study of the S* and similar systems, 6:17680
KARLSRUHE NUCLEAR RESEARCH CENTER
See KERNFORSCHUNGSZENTRUM KARLSRUHE
KENTUCKY
Economic Impact
Economic impact of implementing RACT (reasonably available control technology) guidelines in the state of Kentucky. Final report, 6:17388 (PB—80-206980)
Geochemical Surveys
Geochemistry studies in Eastern Kentucky. Final report, 6:16464 (DOE/ET/12138—T3)
Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report, 6:16463 (DOE/ET/12138—T2)
Magnetic Surveys
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))
Maps
Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report, 6:16463 (DOE/ET/12138—T2)
Radiometric Surveys
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))
Water Resources
Water resources appraisals for hydroelectric licensing: Cumberland River Basin, Kentucky and Tennessee. Planning status report, 6:16624 (FERC—0077)
KERNFORSCHUNGSZENTRUM KARLSRUHE
Radioactive Waste Disposal
Research and development on ultimate storage of radioactive wastes. Annual report, 1977, 6:16558 (ORNL-tr—4740)
KETO ACIDS
(For CARBOXYLIC ACIDS only.)
Quantitative Chemical Analysis
Quantitation of labile keto bile acids in biological samples by sodium borodeuteride reduction prior to isolation and isotope ratio measurements of hydroxyl bile acids, 6:17481
KETONES
See also ACETONE
ACETYLACETONE
Radiopharmaceuticals
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
Scintiscanning
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
KEV RANGE 100-1000
Gamma Detection
High energy photon response, 6:17309 (PNL—3536)
KICKER MAGNETS
Performance
AGS fast kicker magnet system, 6:17265 (BNL—29187)
Design of fast kickers for the ISABELLE beam abort system, 6:17293 (BNL—29218)
KIDNEYS
Pathological Changes
Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)
KINASES (PHOSPHOTRANSFERASES)
See PHOSPHOTRANSFERASES
KINK INSTABILITY
Theory of m = 1 modes in collisionless plasmas, 6:17804
Thermal background effects on the kink instability of a field-reversing ion layer, 6:17776 (PPPL—1755)
KNOCK-ON ELECTRONS
See ELECTRONS
KOREA (SOUTH)
See REPUBLIC OF KOREA
KRYPTON
Ion-Atom Collisions
Collisional decomposition of UF_6p, 6:17619
Measuring Methods
Cryogenic method for measuring nuclides and fission gases (Patent), 6:17323
KRYPTON 86 REACTIONS
Deep Inelastic Heavy Ion Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720

L

LABELLED COMPOUNDS
See also CARBON 14 COMPOUNDS
RADIOPHARMACEUTICALS
TRITIUM COMPOUNDS
Chemical Preparation
Design and synthesis of new radiopharmaceuticals, 6:17194 (DOE/EV/04115—4)
Metabolism
Metabolic mapping of the brain's response to visual stimulation: studies in humans, 6:17515
LABOR
Productivity
Labor productivity in heavy construction: impact on synfuels program employment, 6:17447 (ANL/AA—24)
LAKES
Water Chemistry
Paleochemistry of Plio-Pleistocene Lake Turkana, Kenya, 6:17546
LAMBDA NEUTRAL
See LAMBDA PARTICLES
LAMBDA PARTICLES
Particle Production
Polarization in inclusive lambda production, 6:17628 (DOE/ER/01764—397)
LAMPF LINAC
Beam Dynamics
LAMPF dual-energy operation, 6:17257 (LA-UR—81-730)
Beam Monitors
LAMPF hardware beam transmission monitor systems, 6:17277 (LA-UR—81-731)
Beam Transport
Redesign of the LAMPF transition region, 6:17258 (LA-UR—81-737)
Muon Beams
Beam characteristics in the LAMPF biomedical channel, 6:17281 (LA-UR—81-805)
LAND RECLAMATION
Health Hazards
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
Materials Testing
Chemistry of bottom sediments from the Cal-Sag channel and the Des Plaines and Illinois Rivers between Joliet and Havana, Illinois, 6:17433 (ANL/ES—112)
LANTHANUM ALLOYS
Hydridation
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1980-February 28, 1981 ($LaNi_5$; $LaCo_5$), 6:16599 (DOE/ER/05246—T1)
LANTHANUM CHROMITES
See CHROMIUM OXIDES

LARVAE
Entrainment
Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)
LASER FUSION REACTORS
Fuel Pellets
Cryogenic laser fusion targets by point-contact conduction cooling, 6:16586
Process Heat
Laser fusion systems for industrial process heat. Final report, 6:17834 (DOE/TIC—11435(Vol.1))
Laser fusion systems for industrial process heat. Final report, 6:17835 (DOE/TIC—11435(Vol.2))
Synthetic Fuels
Synthetic fuels from laser fusion, 6:16588
LASER ISOTOPE SEPARATION
Optical Reflection
Procedure and device for illuminating a three-dimensional area with a radiation beam, 6:16551 (ORNL-tr—4734)
LASER RADIATION
Damage
New photographic technique for observing bulk laser damage, 6:17078 (UCRL—84843)
Energy Density
Fluence in 1064-nm laser beams: its determination by photography with Polariod film, 6:17223
LASER TARGETS
Fabrication
Cryogenic laser fusion targets by point-contact conduction cooling, 6:16586
Research Programs
Automated fabrication, characterization and transport of ICF pellets. Final report, March 1, 1979-October 31, 1980, 6:16585 (DOE/DP/40083—1)
X-Ray Spectra
System for automatic x-ray-image analysis, measurement, and sorting of laser fusion targets, 6:17886 (UCRL—84549)
LASER-PRODUCED PLASMA
Plasma Diagnostics
Pulsed versus direct current calibration of a proximity focused x-ray streak camera, 6:17764 (LA—8425-MS)
Threshold Energy
Threshold conditions for laser-initiated plasma shutters, 6:17762
X-Ray Spectra
Pulsed versus direct current calibration of a proximity focused x-ray streak camera, 6:17764 (LA—8425-MS)
LASERS
See also CARBON DIOXIDE LASERS
FREE ELECTRON LASERS
GAS LASERS
Excitation
Coherence in laser excitation, 6:17221 (UCRL—84260)
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)
LATENT HEAT STORAGE
Phase Change Materials
Modeling of phase-change processes with time-varying critical temperature, 6:16880 (ORNL/CSD/TM—145)
LATTICE FIELD THEORY
Spin
Study of Λ parameters and crossover phenomena in SU(N) x SU(N) sigma models in two dimensions, 6:17676 (DOE/ER/03130—T2)
LATTICES (CRYSTAL)
See CRYSTAL LATTICES
LAUNDRIES
Energy Conservation
Reduction of energy usage in the Laundromat. Final report, 6:17036 (DOE/R5/10151—1)
Retrofitting
Reduction of energy usage in the Laundromat. Final report, 6:17036 (DOE/R5/10151—1)
Solar Water Heating
Reduction of energy usage in the Laundromat. Final report, 6:17036 (DOE/R5/10151—1)
LAWRENCE BERKELEY LABORATORY
Energy Analysis
Energy Analysis Program, FY 1980, 6:16888 (LBL—11972)
Research Programs
Energy and Environment Division annual report, 1979, 6:17355 (LBL—11650)
LEAD
Dissociation Energy
Dissociation energies of molecules with very heavy atoms from mass spectrometry, 6:17622
Proton Reactions
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
Neutron yields and spectra from 590 MeV (p,n) reactions on lead targets, 6:17725 (DOE/NDC—21/L(Vol.1))
Proton Transport
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
Recycling
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)
LEAD 192
Decay
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)
LEAD 203
Excretion
In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs (Thesis), 6:17535 (UR—3490-1883)
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Tissue Distribution
In vivo distribution and excretion studies and in vitro blood studies on the kinetics of lead-203 in beagle dogs (Thesis), 6:17535 (UR—3490-1883)
LEAD 208
Giant Resonance
Giant resonance studies with high energy heavy ions, 6:17697 (INKA-Conf—79-001-000)
LEAD 208 TARGET
Oxygen 16 Reactions
Giant resonance studies with high energy heavy ions (315 MeV), 6:17697 (INKA-Conf—79-001-000)
LEAD-ACID BATTERIES
Battery Charging
Electric and hybrid vehicles charge efficiency tests of ESB EV-106 lead-acid batteries, 6:17068 (DOE/CS/54209—T1)
Performance
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments, 6:17065 (CONF-800523—4)
Technology Assessment
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
LEAK DETECTORS
Performance
Leak checking in ISABELLE, 6:17262 (BNL—29148)
LEASES
Economic Impact
Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)
Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development

scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)

Environmental Impact Statements

Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69, 6:16500 (NP—25371)

Social Impact

Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)

Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)

Socio-Economic Factors

Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16492 (PB—80-210289)

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LENSES

Design

Lens design and local minima, 6:17230

LEP STORAGE RINGS

Reviews

CERN LEP project, 6:17300 (SLAC—239)

LEPTON-HADRON INTERACTIONS

Neutral-Current Interactions

Theoretical and experimental review of the weak neutral current: a determination of its structure and limits on deviations from the minimal SU(2)/sub L/ x U(1) electroweak theory, 6:17645

LEPTONIC DECAY

Quantum Chromodynamics

QCD corrections to quarkonia decays, 6:17652 (ANL-HEP-CP—80-60)

LEPTONS

See also ELECTRONS
MUONS
NEUTRINOS

Mass

From the standard model to composite quarks and leptons. Part I. Standard model, its present status and its open problems. Part II. Composite quarks and leptons, 6:17661 (SLAC—239)

LIGHT

See VISIBLE RADIATION

LIGHT NUCLEI

Neutron Reactions

Differential scattering cross section measurements above 20 MeV, 6:17695 (DOE/NDC—21/L(Vol.1))

LIGHT SCATTERING

Seasonal Variations

Seasonal variations in light scattering in the New York region and their relation to sources, 6:17349 (BNL—29271)

LIGHTING SYSTEMS

Cost

Cost analysis for upgraded passenger car rear signal lighting requirements. Final report, December 1979-June 1980, 6:16983 (PB—80-219728)

Government Policies

Lighting issues in the 1980's: summary and proceedings of a lighting roundtable held at New York, New York on June 14 and 15, 1979. Final report, 6:16975 (PB—80-222714)

Meetings

Lighting issues in the 1980's: summary and proceedings of a lighting roundtable held at New York, New York on June 14 and 15, 1979. Final report, 6:16975 (PB—80-222714)

LIGNIN

Decomposition

Chemical Process Research and Development Program, 6:16615 (LBL—11650)

LIGNITE

Energy Source Development

Evaluation of the impact of Texas lignite development on Texas water resources. Technical completion report, 1 July 1976-30 September 1977, 6:16415 (PB—80-220635)

LIMBS

Beta Dosimetry

Extremity dosimeter studies, 6:17314 (PNL—3536)

Neutron Dosimetry

Extremity dosimeter studies, 6:17314 (PNL—3536)

Personnel Dosimetry

Extremity dosimeter studies, 6:17314 (PNL—3536)

LIME-LIMESTONE WET SCRUBBING PROCESSES

Corrosion

Construction materials for wet scrubbers. Volume 2. Final report, 6:16406 (EPRI-CS—1736(Vol.2))

LIMESTONE

Hydraulic Fracturing

Hydraulic-fracture propagation in layered rock: experimental studies of fracture containment, 6:16519 (SAND—80-2219C)

LIMITERS

Coatings

Thermal-fatigue testing of coatings for fusion-reactor applications, 6:17108 (SAND—80-2431C)

Materials Testing

Testing of low-Z-coated limiters in tokamak fusion devices, 6:17831

LINACS

See LINEAR ACCELERATORS

LINEAR ACCELERATORS

See also LAMPF LINAC
UNILAC

Beam Currents

Current limits in linear accelerators, 6:17250

Beam Transport

MEQALAC development at Brookhaven, 6:17271 (BNL—29305)

Specifications

Advanced Test Accelerator (ATA) pulse power technology development, 6:17282 (UCRL—85037)

X-Ray Sources

Design and performance of the 1.5 MV injector for FXR, 6:17283 (UCRL—85060)

LINEAR THETA PINCH DEVICES

Plasma Macroinstabilities

Periodic field-reversed equilibria for a multiple-cell linear theta pinch, 6:17791 (PPPL—1755)

LINEAR Z PINCH DEVICES

Magnetohydrodynamics

Dynamic and quasi-equilibrium Lagrangian MHD in 1-D, 6:17824

One-Dimensional Calculations

Dynamic and quasi-equilibrium Lagrangian MHD in 1-D, 6:17824

LINKING (BOREHOLE)

See BOREHOLE LINKING

LINUS REACTORS

Reviews

Linus reactor: compression of a compact torus by a liquid metal liner, 6:17873 (PPPL—1755)

LIPOSOMES
Electron Transfer
Mechanisms of photochemical energy conversion by chlorophyll. Progress report, April 1, 1980-March 30, 1981, 6:17467 (DOE/ER/04927—T2)
LIQUEFACTION
See also COAL LIQUEFACTION
Chemistry
Liquefaction of Douglas Fir wood slurries: titration of acids and anions in aqueous product and feed slurries, 6:16606 (LBL—12331)
LIQUEFIED NATURAL GAS
See also LNG INDUSTRY
Boiling
LNG storage: safety analysis. Annual report for 1979, 6:16522 (PB—80-210750)
Electric Conductivity
Electrostatic charge generation in hydrocarbon liquids. Final report, January 1978-August 1979, 6:16523 (PB—80-210768)
Gas Spills
Experimental plan for 40-m^3 liquefied natural gas (LNG) dispersion tests. 1981 tests, 6:16515 (UCID—18585(Suppl.1))
Recommended research on LNG safety, 6:16512 (DOE/EV/10024—1)
Heat Transfer
LNG storage: safety analysis. Annual report for 1979, 6:16522 (PB—80-210750)
Phase Transformations
Experimental plan for 40-m^3 liquefied natural gas (LNG) dispersion tests. 1981 tests, 6:16515 (UCID—18585(Suppl.1))
LNG storage: safety analysis. Annual report for 1979, 6:16522 (PB—80-210750)
Safety
Recommended research on LNG safety, 6:16512 (DOE/EV/10024—1)
Safety Engineering
Liquefied natural gas (LNG) safety studies, 6:17454 (PNL—3700(Pt.5))
Storage
LNG storage: safety analysis. Annual report for 1979, 6:16522 (PB—80-210750)
Vapor Condensation
Liquefied natural gas gels: structure, rheology, and production energy requirements. Final report, January 1976-December 1979, 6:16521 (PB—80-210685)
LIQUEFIED PETROLEUM GASES
Boiling
Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Diffusion
Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Research Programs
Liquefied petroleum gas (LPG) research assessment, 6:17455 (PNL—3700(Pt.5))
LIQUID ASPHALT
See RESIDUAL FUELS
LIQUID CRYSTALS
Photoacoustic Spectroscopy
Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650)
LIQUID METAL FAST BREEDER REACTORS
See LMFBR TYPE REACTORS
LIQUID METAL TEST FACILITIES
See TEST FACILITIES
LIQUID WASTES
See also WASTE WATER
Denitrification
Bio-oxidation of thiocyanates typical of coal conversion effluents. Final report, 6:16402 (DOE/ET/04502—7)
LIQUIDS
See also LIQUID CRYSTALS
Hall Effect
Study of the motion of electrons in non polar classical liquids. Measurement of Hall effect and f.i.r. search for low energy traps. Progress report, 6:17748 (DOE/ER/10375—T1)
LITHIUM
Atom Collisions
Low work function surface for improving the yield of negative hydrogen ions, 6:17578 (BNL—51304)
Corrosive Effects
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)
Electron-Atom Collisions
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)
Ion-Atom Collisions
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
LITHIUM 6 TARGET
Neutron Reactions
Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD, 6:17692 (DOE/NDC—21/L(Vol.1))
LITHIUM 7 REACTIONS
Compound-Nucleus Reactions
Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
LITHIUM 7 TARGET
Beryllium 9 Reactions
Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
LITHIUM COMPOUNDS
Dissociation Energy
Dissociation energies of molecules with very heavy atoms from mass spectrometry, 6:17622
Fabrication
Advanced fuel-cell development. Progress report, January-March 1980 (β-$LiAlO_2$), 6:16946 (ANL—80-67)
Mechanical Properties
Advanced fuel-cell development. Progress report, January-March 1980 (β-$LiAlO_2$), 6:16946 (ANL—80-67)
LITHIUM DEUTERIDES
Neutron Reactions
Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD, 6:17692 (DOE/NDC—21/L(Vol.1))
LITHIUM HYDRIDES
Ion Collisions
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)
LITHIUM OXIDES
Neutron Reactions
Neutronic calculations for the conceptual design of an in-reactor solid breeder experiment, TRIO-01, 6:17839 (ORNL/TM—7758)
LIVER
Aminotransferases
Chronotypic induction of tyrosine aminotransferase by α-methyl-p-tyrosine (Rat liver), 6:17471
Positron Computed Tomography
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
LIZARDS
Ecology
Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397
Eggs
Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397
LMFBR TYPE REACTORS
See also EBR-2 REACTOR
Air Cleaning Systems
Large-scale tests of aqueous scrubber systems for LMFBR vented containment, 6:16872 (HEDL-SA—2121-FP)
Fuel Assemblies
Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)

Influence of core-assembly refueling requirements on LMFBR core-system design, 6:16839 (GEFR-SP—146)
Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)
Fuel Pins
Development of variable-width ribbon heating elements for liquid-metal and gas-cooled fast breeder reactor fuel-pin simulators, 6:16845 (ORNL—5690)
Examination of fast-reactor fuels and FBR analytical quality-assurance standards and methods. Progress report, October 1-December 31, 1980, 6:16844 (LA—8742-PR)
Loss of Flow
Development of a model to predict flow oscillations in low-flow sodium boiling (Loss-of-Piping Integrity accidents), 6:16867 (DOE/ET/37218—2)
Method and apparatus for reducing the power level in a nuclear reactor during temperature transient (Patent), 6:16853
Reactor Accidents
Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)
Large-scale tests of aqueous scrubber systems for LMFBR vented containment, 6:16872 (HEDL-SA—2121-FP)
Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)
Reactor Cooling Systems
Inelastic behavior of a dissimilar-metal-welded pipe transition joint: comparison of experimental measurements and analytical prediction, 6:16840 (GEFR-SP—148)
Reactor Fueling
Influence of core-assembly refueling requirements on LMFBR core-system design, 6:16839 (GEFR-SP—146)
Reactor Shutdown
Method and apparatus for reducing the power level in a nuclear reactor during temperature transient (Patent), 6:16853
Thermal Insulation
Thermal-performance study of liquid metal fast breeder reactor insulation, 6:16837 (ANL—80-97)
Transients
Development of models for the sodium version of the two-phase three-dimensional thermal hydraulics code THERMIT, 6:16868 (DOE/ET/37218—3)

LNG
See LIQUEFIED NATURAL GAS

LNG INDUSTRY
Environmental Impacts
Recommended research on LNG safety, 6:16512 (DOE/EV/10024—1)
Safety
Recommended research on LNG safety, 6:16512 (DOE/EV/10024—1)

LOAD MANAGEMENT
Cost Benefit Analysis
Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options, 6:16934 (NP—25348)
Evaluation
Electric Utility Rate Design Study: cost-benefit methodology for evaluation of load-management options, 6:16934 (NP—25348)
Social Impact
Electric utility rate design study: costs and benefits of load management to society, 6:16933 (NP—22593)

LOADING (REACTOR)
See REACTOR FUELING

LOCAL GOVERNMENT
Energy Policy
Local government energy programs: status, opportunities, and recommendations for state support, 6:16919

LONG VALLEY
Geology
Preliminary Hot Dry Rock geothermal evaluation of Long Valley Caldera, California, 6:16738 (LA—8710-HDR)
Heat Flow
Preliminary Hot Dry Rock geothermal evaluation of Long Valley Caldera, California, 6:16738 (LA—8710-HDR)
Seismic Surveys
Preliminary Hot Dry Rock geothermal evaluation of Long Valley Caldera, California, 6:16738 (LA—8710-HDR)

LONGWALL MINING
Dusts
Reducing dust at longwall shearers by confining the dust cloud to the face, 6:16424 (BM-TPR—111)
Powered Supports
Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980, 6:16428 (DOE/TIC—11445)
Shearer Loaders
Reducing dust at longwall shearers by confining the dust cloud to the face, 6:16424 (BM-TPR—111)

LOS ALAMOS MESON PHYSICS FACILITY
See LAMPF LINAC

LOSS OF COOLANT
Computer Graphics
Graphic display of spatially distributed binary-state experimental data (PWR; BWR), 6:16861 (CONF-810235—1)
Heat Transfer
Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)
TRAC-BD1: transient reactor analysis code for boiling-water systems, 6:16862 (CONF-810307—3)
Hydraulics
Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)
Graphic display of spatially distributed binary-state experimental data (PWR; BWR), 6:16861 (CONF-810235—1)
TRAC-BD1: transient reactor analysis code for boiling-water systems, 6:16862 (CONF-810307—3)

LOSS OF FLOW
Development of a model to predict flow oscillations in low-flow sodium boiling (Loss-of-Piping Integrity accidents), 6:16867 (DOE/ET/37218—2)

LOW BTU GAS
Chemical Composition
Coal gasification of a central heating plant (U. of Minnesota, Duluth campus; gas and oil firing), 6:16393
Desulfurization
Hot-gas desulfurization. II. Use of gasifier ash in a fluidized-bed process. Final report, 6:16349 (DOE/ET/10463—T1(Vol.2))

LOW DOSE IRRADIATION
Response Functions
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Statistical and low dose response, 6:17315 (PNL—3536)

LOW-HEAD HYDROELECTRIC POWER PLANTS
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939

LP-GAS
See LIQUEFIED PETROLEUM GASES

LUMINAL
See PHENOBARBITAL

LUNG CELLS
See RESPIRATORY TRACT CELLS

LUNG CLEARANCE
Mathematical Models
Tracheobronchial clearance studies in the guinea pig, 6:17513 (UR—3490-1981)

LURGI PROCESS
Comparative Evaluations
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)

LURGI SLAGGING PROCESS
Comparative Evaluations
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
LUTETIUM FLUORIDES
Specific Heat
Thermodynamics of the lanthanide trifluorides. IV. The heat capacities of gadolinium trifluoride GdF_3, lutetium trifluoride LuF_3, and yttrium trifluoride YF_3 from 5 to 350°K, 6:17149
LUTETIUM SULFIDES
Orthorhombic Lattices
Crystal-structure determinations of Lu_3S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)
LUXEMBOURG
Energy Demand
Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912
LYMPHOBLASTOMAS
See LYMPHOMAS
LYMPHOCYTES
Population Dynamics
Cell cycle kinetics in human lymphocyte cultures, 6:17518
LYMPHOGRANULOMAS
See LYMPHOMAS
LYMPHOID CELLS
See LYMPHOCYTES
LYMPHOMAS
Biological Effects
Tissue enzyme changes in parabiotic rats with subcutaneous lymphoma, 6:17469 (DOE/EV/03017—T1)

M

MA 754
See NICKEL BASE ALLOYS
MA 956
See IRON BASE ALLOYS
MACHINE PARTS
See also MECHANICAL TRANSMISSIONS
Surface Finishing
Burrs formed in producing small holes, 6:17107 (RFP—3195)
MACHINE TOOLS
Design
Gage chucking mechanism. Final report, 6:17204 (BDX—613-2560)
Performance Testing
Gage chucking mechanism. Final report, 6:17204 (BDX—613-2560)
MAGMA SYSTEMS
Geology
Geology of magma systems: background and review, 6:16728 (SAND—80-1959)
MAGNESIUM
Atom-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Ion-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Theoretical investigations of the collision dynamics in H^- formation and destruction, 6:17571 (BNL—51304)
MAGNESIUM 24
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
MAGNESIUM FLUORIDES
Elasticity
Single-crystal elastic constants of MgF_2 in the temperature range 4.2—300 K, 6:17151
MAGNESIUM OXIDES
Optical Properties
High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers, 6:17890
Order-Disorder Transformations
Glassy thin films. Final report, 6:17118 (DOE/DP/40095—T1)
MAGNETIC FLUX
Monitoring
Novel current monitor for DC and modulated magnets in the proton storage ring, 6:17299 (LA-UR—81-781)
MAGNETIC MIRROR CONFIGURATIONS
Ion Rings
Reversed field configurations generated by proton pulses, 6:17851 (PPPL—1755)
Magnetic Field Configurations
Triggered-reconnection compact toroid experiment, 6:17860 (PPPL—1755)
Magnetic Field Reversal
Particle-fluid hybrid simulation of field reversal in a mirror plasma, 6:17854 (PPPL—1755)
Reversed field configurations generated by proton pulses, 6:17851 (PPPL—1755)
Steady state beam driven field-reversed mirror, 6:17855 (PPPL—1755)
Two dimensional time-dependent transport in field reversed equilibria, 6:17780 (PPPL—1755)
Plasma Macroinstabilities
Calculation of ideal MHD growth rates and eigenfunctions in field reversed mirrors in the large toroidal mode number limit, 6:17781 (PPPL—1755)
Transport Theory
Two dimensional time-dependent transport in field reversed equilibria, 6:17780 (PPPL—1755)
MAGNETIC MIRRORS
See also MFTF DEVICES
TMX DEVICES
Electron Beam Injection
Results and present status of the relativistic electron ring experiments and their application to Spheromak problems, 6:17850 (PPPL—1755)
MAGNETIC SEPARATORS
Performance
Application of coal petrography to the evaluation of magnetically separated dry crushed coals, 6:16444 (CONF-810203—7)
MAGNETIC VORTICES
See MAGNETIC FLUX
MAGNETOHYDRODYNAMIC CHANNELS
See MHD CHANNELS
MAGNETOHYDRODYNAMIC GENERATORS
See MHD GENERATORS
MAGNETOHYDRODYNAMIC WAVES
See HYDROMAGNETIC WAVES
MAGNETOHYDRODYNAMICS
Hydromagnetic Waves
Fluctuations in combustion-driven MHD generators, 6:16943 (DOE/ET/15611—1)
MAGNETOTELLURIC SURVEYS
Computer Codes
Interactive modeling system for 2-D magneto-telluric and line source resistivity data (MT2D users guide and documentation), 6:16729 (DOE/ET/27002—1)
Data Analysis
Interactive modeling system for 2-D magneto-telluric and line source resistivity data (MT2D users guide and documentation), 6:16729 (DOE/ET/27002—1)
Telluric-magnetotelluric method in two- and three-dimensional environments, 6:16732 (DOE/ET/28392—25)
MAGNETRONS
Performance
Operation of the Fermilab H^- magnetron source, 6:17581 (BNL—51304)
MAINE
Peat
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)

MAIZE
Fermentation
Energy balances in the production and end use of alcohols derived from biomass. A fuels-specific comparative analysis of alternate ethanol production cycles, 6:16648 (DOE/PE/70151—T5)
MALAYSIA
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)
MALES
Diet
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
MALONIC ACID
Oxidation
Existence of solitary traveling wave solutions of a model of the Belousov-Zhabotinskii reaction, 6:17175
MAMMARY GLANDS
Biomedical Radiography
Observed detector characteristics in mammography: suggestions for further studies, 6:17496
MANGANESE 56
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
MANGANESE COMPLEXES
Electronic Structure
Axial ligand effects on iron and manganese porphyrins: extended Hueckel calculations of Cyt P450 analogs and of O_2 binding to iron and manganese, 6:17162
MANUFACTURERS
Energy Conservation
Saving money through employee motivation and participation in energy conservation, 6:17022 (CONF-800483—(Vol.2))
MARINE DISPOSAL
Technology Assessment
Geothermal liquid waste disposal, 6:17457 (PNL—3700(Pt.5))
MARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS
MARSHALL ISLANDS
See also BIKINI
ENIWETOK
Diet
Marshall Islands: a study of diet and living patterns, 6:17542 (BNL—51313)
Life Styles
Marshall Islands: a study of diet and living patterns, 6:17542 (BNL—51313)
MARSHES
Carbon Cycle
Flax pond ecosystem study: exchanges of CO_2 between a salt marsh and the atmosphere, 6:17400
MASS SPECTROMETERS
Sensitivity
Static $^3He/^4He$ gas mass spectrometer for low level tritium concentration measurements, 6:17326 (DP-MS—80-105)
MASSACHUSETTS
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
MECHANICAL STRUCTURES
See also POWER TRANSMISSION TOWERS
Dynamics
Parameter estimation in structural dynamics models, 6:17211 (SAND—80-0135)
Mathematical Models
Parameter estimation in structural dynamics models, 6:17211 (SAND—80-0135)
MECHANICAL TRANSMISSIONS
Design
Advanced continuously variable transmissions for electric and hybrid vehicles, 6:17069 (DOE/NASA/51044—17)
Stresses
Vertical-axis wind-turbine drive-train transient dynamics, 6:16781 (SAND—80-2646)
Torque
Vertical-axis wind-turbine drive-train transient dynamics, 6:16781 (SAND—80-2646)
MEIOSIS
Complexes
Synaptonemal complexes at premeiotic interphase in the mouse spermatocyte, 6:17475
MELANIN
Biochemical Reaction Kinetics
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
MELANOCYTES
See MELANIN
MELANOMAS
Biochemical Reaction Kinetics
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Correlations
Serum copper and zinc levels in melanoma patients, 6:17493
Uptake
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
MEMBRANES
See also CELL MEMBRANES
PHOTOSYNTHETIC MEMBRANES
Electron Transfer
Electron transport across glycerol monooleate bilayer lipid membranes facilitated by magnesium etiochlorin, 6:17470
MENTAL DISORDERS
Epidemiology
Epidemiological investigations concerning affective disorders, 6:17464
MERCURY
Ultraviolet Spectra
Mercury—ammonia system at high mercury densities, 6:17222
MERCURY 197
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
MERCURY 203
Comparative Evaluations
Design and synthesis of new radiopharmaceuticals, 6:17194 (DOE/EV/04115—4)
MESONS
Mass Formulae
Effect of exchange-energy corrections on self-consistent meson masses and on the equation of state of nuclear matter, 6:17740
Particle Production
Study of different forms for the recombination function in the formation of mesons from partons, 6:17657 (IS-T—929)
Quantum Chromodynamics
Study of different forms for the recombination function in the formation of mesons from partons, 6:17657 (IS-T—929)
METABOLISM
Nuclear Magnetic Resonance
Recent applications of ^{13}C NMR spectroscopy to biological systems, 6:17157 (LA-UR—81-898)
METABOLITES
Biochemical Reaction Kinetics
Regulatory coupling of nitrate and sulfate assimilation pathways in cultured tobacco cells, 6:17474
Quantitative Chemical Analysis
Specificity in interaction of benzo[a]pyrene with nuclear macromolecules: implication of derivatives of two dihydrodiols in protein binding, 6:17473
METACERCARIAE
See LARVAE
METAGALAXY
See UNIVERSE
METAL INDUSTRY
Energy Balance
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Energy Conservation
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Energy Consumption
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)

Material Balance
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Materials Recovery
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)
Smelting
Energy and materials flows in the copper industry, 6:16985 (ANL/CNSV—11)
Steels
Conservation: an in-plant energy resource, 6:17031 (CONF-800483—(Vol.2))
Waste Product Utilization
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)

METALLOIDS
See SEMIMETALS

METALLOTHIONEIN
Radioimmunoassay
Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)

METALS
See also ALKALI METALS
REFRACTORY METALS
Absorption Spectra
Interpretation of differential reflectance studies of metal surfaces, 6:17110
Corrosion
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)
Grain Boundaries
Computer simulation study of the structure of vacancies in grain boundaries, 6:17090 (DOE/ER/05002—15)
Spectral Reflectance
Interpretation of differential reflectance studies of metal surfaces, 6:17110
Work Functions
Properties of alkali metals adsorbed onto metal surfaces, 6:17579 (BNL—51304)

METASTASES
Diagnosis
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494

METHANATION
Catalysts
Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980, 6:16354 (DOE/ET/14815—20)
Investigation of carbon deposition on fluidized methanation catalysts. Appendix, 6:16355 (DOE/ET/14815—20)

METHANE
Abundance
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
Biosynthesis
Full scale field demonstration of unheated anaerobic contact stabilization. Quarterly project status report, July 1980-September 1980, 6:16603 (DOE/CS/24310—2)
Peat biogasification, 6:16613 (TR—80/031-001)
Boiling
Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Combustion
Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Diffusion
Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Economics
Economic analysis of vertical wells for coalbed methane recovery, 6:16516 (DOE/MC/08089—107)
Explosions
Orient mine tragedy, Part II: the conditions were ripe for an explosion, 6:16435
Orient mine tragedy: the last shift before Christmas, 6:16436
Ignition
Orient mine tragedy, Part II: the conditions were ripe for an explosion, 6:16435
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Production
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
Production of biogas from waste waters of food-processing indusries, 6:16990 (CONF-800483—(Vol.2))
Recovery
Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)
Economic analysis of vertical wells for coalbed methane recovery, 6:16516 (DOE/MC/08089—107)
Solubility
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Synthesis
Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)
Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)
Viscosity
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)

METHANOL
Production
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
Solvent Properties
Solubilities of acid gases and nitrogen in methanol. Final report, September 1979-April 1980, 6:16616 (PB—80-212236)

METHANOL FUELS
Road Tests
Senate Bill 620: alcohol fuels program, 6:17076 (P—500-81-007)

METHYL IODIDE
Chemical Preparation
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)

METHYLBENZENE
See TOLUENE

MEV RANGE 01-10
Gamma Detection
High energy photon response, 6:17309 (PNL—3536)

MEXICO
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)

MFTF DEVICES
Planning
Flexibility of MFTF-B for thermal-barrier modifications and axisymmetric upgrades, 6:17884 (UCID—18948)
MFTF-B physics requirements, 6:17882 (UCID—18798)

MHD CHANNELS
Electrodes
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Materials Testing
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Turbulent Flow
Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)

MHD GENERATORS
See also COAL-FIRED MHD GENERATORS

OPEN-CYCLE MHD GENERATORS
Electrodes
Ceramic component for electrodes (Patent), 6:16944
Fluctuations
Fluctuations in combustion-driven MHD generators, 6:16943 (DOE/ET/15611—1)
Hydromagnetic Waves
Fluctuations in combustion-driven MHD generators, 6:16943 (DOE/ET/15611—1)
MICA
Wettability
Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs (Surfactants - carboxymethylized oxyethylate, naphthenic acid betaine, alkylsulfonate), 6:16472 (CONF-8004140—)
MICE
Ehrlich Ascites Tumor
Astatine-211-tellurium radiocolloid cures experimental malignant ascites, 6:17514
MICELLAR SYSTEMS
Radiolysis
Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study, 6:17191
MICELLAR-POLYMER FLOODING
See MICROEMULSION FLOODING
MICHIGAN
Peat
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
MICROBIAL FLORA
See MICROORGANISMS
MICROELECTRONIC CIRCUITS
Fabrication
Laser machining of ceramic, 6:17235 (BDX—613-2507)
MICROELECTRONICS
Research Programs
Electronics Engineering Department. Quarterly report No. 3, 1980, 6:17238 (UCRL—50025-80-3)
MICROEMULSION FLOODING
Demonstration Programs
Micellar-polymer oil recovery demonstration in the Bell Creek Field, Montana, 6:16479 (CONF-8004140—)
MICROFLORA
See MICROORGANISMS
MICROORGANISMS
Cellulolytic Activity
Degradation of cellulosic biomass and its subsequent utilization for the production of chemical feedstocks. Final report, February 1, 1978-January 31, 1979, 6:16614 (DOE/ET/20030—1)
MICROPROCESSORS
Research Programs
Electronics Engineering Department. Quarterly report No. 3, 1980, 6:17238 (UCRL—50025-80-3)
MICROWAVE EQUIPMENT
See also SQUID DEVICES
Design
Effects of microwaves on the performance of internal-combustion engines. Final technical report, September 30, 1979-January 31, 1981, 6:17056 (DOE/ET/13116—T13)
MICROWAVE RADIATION
Biological Effects
Preliminary environmental assessment for the satellite power system (SPS), 6:17541
Health Hazards
Preliminary environmental assessment for the satellite power system (SPS), 6:17541
Side Effects
Environmental effects on the Hanford Multipurpose Personnel Dosimeter, 6:17313 (PNL—3536)
MID-ATLANTIC REGION
See also NEW YORK
PUERTO RICO
Interconnected Power Systems
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
MIDWEST REGION
See also IOWA
KANSAS
MISSOURI
NEBRASKA
Interconnected Power Systems
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the South Central Region, 6:16930 (FERC—0053)
MILK
Production
Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
Temperature Measurement
Saving of energy when cooling milk and heating water on farms. Final report, 6:17040
MILL TAILINGS
Waste Processing
Dewatering of industrial clay wastes, 6:17423 (BM-RI—8498)
MINE CARS
Testing
Splice testing using a figure-s machine and a new shuttle car simulation. Open file report, 1 May 1978-30 April 1979, 6:16430 (PB—80-210222)
MINE-MOUTH GENERATING PLANTS
See COAL MINES
FOSSIL-FUEL POWER PLANTS
MINERAL WOOL
See also THERMAL INSULATION
Field Tests
Field investigation of the performance of residential retrofit insulation, 6:16965 (NBS-TN—1131)
MINING
See also AUGER MINING
COAL MINING
HYDRAULIC MINING
SURFACE MINING
UNDERGROUND MINING
Safety Engineering
Selection of PAR mines based on several factors, 6:16440
MINING EQUIPMENT
See also ROOF BOLTS
Comparative Evaluations
Feasibility of high recovery highwall mining equipment. Final report, 6:16425 (DOE/ET/11268—9)
Exhaust Gases
The application of advanced mine air monitoring techniques to mines using diesel powered equipment. Final report, 1 July 1978-31 July 1979, 6:16429 (PB—80-207541)
Prices
Feasibility of high recovery highwall mining equipment. Final report, 6:16425 (DOE/ET/11268—9)
Remote Control
Feasibility of high recovery highwall mining equipment. Final report, 6:16425 (DOE/ET/11268—9)
MINNESOTA
Peat
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Wind Power
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)
MIRROR FUSION TEST FACILITY
See MFTF DEVICES
MIRRORS
Configuration
Proposed rear view mirror characteristics and costs. Final report, January-April 1980, 6:16982 (PB—80-208218)
Cost
Proposed rear view mirror characteristics and costs. Final report, January-April 1980, 6:16982 (PB—80-208218)
Fabrication
Method of making reflecting film reflector (Patent), 6:16723

Regulations
Proposed rear view mirror characteristics and costs. Final report, January-April 1980, 6:16982 (PB—80-208218)

MIRRORS (MAGNETIC)
See MAGNETIC MIRRORS

MISSISSIPPI
Water Resources
Water resources appraisals for hydroelectric licensing: Tombigbee-Warrior River Basin, Alabama and Mississippi. Planning status report, 6:16625 (FERC—0078)

MISSOURI
Aerial Monitoring
The RAPS (regional air pollution study) helicopter air pollution measurement program, St. Louis, Missouri, 1974-76. Final report, 6:17361 (PB—80-213119)
Air Quality
The RAPS (regional air pollution study) helicopter air pollution measurement program, St. Louis, Missouri, 1974-76. Final report, 6:17361 (PB—80-213119)

MOBILITY
Control
Development of mobility control methods to improve oil recovery by CO_2. First annual report, October 1, 1979-September 30, 1980, 6:16488 (DOE/MC/10689—5)

MODELS (FUNCTIONAL)
See FUNCTIONAL MODELS

MODELS (NUCLEAR)
See NUCLEAR MODELS

MODELS (PLASMA)
See PLASMA SIMULATION

MOLECULAR IONS
Polarizability
INDO and MINDO/3 atom-in-molecule polarizabilities, 6:17614

MOLECULAR ORBITAL MODEL
See MOLECULES

MOLECULES
Polarizability
INDO and MINDO/3 atom-in-molecule polarizabilities, 6:17614
Potential Energy
WMIN: a computer program to model molecules and crystals in terms of potential energy functions, 6:17169 (ORNL—5747)

MOLTEN CARBONATE FUEL CELLS
Cathodes
Advanced fuel-cell development. Progress report, January-March 1980, 6:16946 (ANL—80-67)
Matrix Materials
Advanced fuel-cell development. Progress report, January-March 1980, 6:16946 (ANL—80-67)
Performance
Effects of sulfur-containing gases on the performance of molten carbonate fuel cells, 6:16951 (EPRI-EM—1699)
Poisoning
Effects of sulfur-containing gases on the performance of molten carbonate fuel cells, 6:16951 (EPRI-EM—1699)
Technology Assessment
Status of molten carbonate fuel cell technology, 6:16948 (CONF-810315—8)

MOLTEN SALT COAL GASIFICATION PROCESS
Process Development Units
Molten Salt Coal Gasification Process Development Unit. Phase 2. Quarterly technical progress report No. 2, October-December 1980, 6:16348 (DOE/ET/10296—71)

MOLTEN SALTS
Corrosive Effects
Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Physical Properties
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)

MOLYBDENUM
Ecological Concentration
Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583
Sulfidation
Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report, 6:17097 (DOE/ET/10404—2)

MOLYBDENUM ALLOYS
Crack Propagation
Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II (HSLA steels; Ti-30 Mo), 6:17095 (DOE/ER/10433—2)

MOLYBDENUM OXIDES
Electrodeposition
Black chromium-molybdenum: a new stable solar absorber, 6:16721
Spectral Reflectance
Black chromium-molybdenum: a new stable solar absorber, 6:16721
Surface Properties
Chemisorption of carbon monoxide on reduced molybdena, 6:17173

MONTANA
Magnetic Surveys
Aerial radiometric and magnetic survey: Glasgow National Topographic Map, Montana. Final report, 6:16539 (GJBX—82(81))
Radiometric Surveys
Aerial radiometric and magnetic survey: Glasgow National Topographic Map, Montana. Final report, 6:16539 (GJBX—82(81))

MOTORCYCLES
Exhaust Gases
Exhaust emissions and fuel economy of three prototype Honda motorcycles. Technical report, 6:17060 (PB—80-210453)
Fuel Economy
Exhaust emissions and fuel economy of three prototype Honda motorcycles. Technical report, 6:17060 (PB—80-210453)

MOUND LABORATORY
Radiation Monitoring
Annual environmental monitoring report: Calendar Year 1980, 6:17441 (MLM—2822)

MULTILAMELLAR LIPID VESICLES
See LIPOSOMES

MULTI-NUCLEON TRANSFER REACTIONS
Differential Cross Sections
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720

MULTIPHASE FLOW
Numerical Solution
Overview of multifluid-flow-calculation methods, 6:17224 (BNL—29189)
Subsonic Flow
Overview of multifluid-flow-calculation methods, 6:17224 (BNL—29189)

MULTIVARIATE ANALYSIS
Geostatistics project of the National Uranium Resource Evaluation program. Progress report, April-September 1980, 6:16548 (GJBX—99(81))
Manuals
Statistical techniques applied to aerial radiometric surveys (STAARS): principal components analysis user's manual, 6:16534 (GJBX—9(81))

MULTIWIRE PROPORTIONAL CHAMBERS
See also DRIFT CHAMBERS
Charge Collection
Drift and proportional tracking chambers, 6:17316 (SLAC—239)
Electron Drift
Drift and proportional tracking chambers, 6:17316 (SLAC—239)
Reviews
Drift and proportional tracking chambers, 6:17316 (SLAC—239)

Spatial Resolution
Drift and proportional tracking chambers, 6:17316 (SLAC—239)

MUNICIPAL WASTES
Combustion
Environmental assessment of a waste-to-energy process: Braintree municipal incinerator, 6:17362 (PB—80-219421)
Pyrolysis
Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)
Pyrolysis Products
Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)

MUON NEUTRINOS
Weak Interactions
Neutrinos and neutrino interactions, 6:17659 (SLAC—239)

MUON PAIRS
Particle Production
Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647

MUON REACTIONS
Fission
Fission yields and lifetimes for muon induced fission in ^{235}U and ^{238}U, 6:17736
Weak Interactions
Results from CERN muon scattering experiments, 6:17639 (SLAC—239)

MUONIC ATOMS
Isomer Shift
Investigation of the ^{203} ^{205}Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)

MUON-NUCLEON INTERACTIONS
Particle Production
Charm production by muons and its role in scale-noninvariance, 6:17630 (DOE/ER/03072—T3)

MUONS
Particle Decay
Possible deviations from (V-A) charged currents: precise measurement of muon decay parameters, 6:17631 (LBL—12275)

MUSEUMS
See EDUCATIONAL FACILITIES

MUTAGEN SCREENING
Dose-Response Relationships
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)

MUTAGENESIS
Dose-Response Relationships
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)
Meetings
Symposium on molecular and cellular mechanisms of mutagenesis, 6:17530 (CONF-810428—(Absts.))

MUTATION FREQUENCY
Dose-Response Relationships
Genetic effects of ethylene dibromide in Drosophila melanogaster, 6:17528 (BNL—29259)

MUTUALISM
See SYMBIOSIS

MX DEVICES
See MFTF DEVICES

MYLAR
Physical Radiation Effects
Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)

MYOCARDIAL INFARCTION
Genetics
Aggregation of deaths from ischaemic heart disease among first and second degree relatives of 108 males and 42 females with myocardial infarction, 6:17501

MYOCARDIUM
Autoradiography
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Scintiscanning
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4)

N

NAPHTHA
Hydrogenation
Review of SRC-II process product hydrotreating data, for completeness and applicability to the demo plant, 6:16383 (ORNL/Sub—7685/1)

NAPHTHENES
See CYCLOALKANES

NATIONAL ACCELERATOR LABORATORY
See FERMILAB ACCELERATOR

NATIONAL ENERGY PLAN
Environmental Impacts
Regional studies, 6:16904 (LBL—11972)
Socio-Economic Factors
Regional studies, 6:16904 (LBL—11972)

NATIONAL SYNCHROTRON LIGHT SOURCE
See NSLS

NATURAL GAS
See also LIQUEFIED NATURAL GAS
Trade
Main-line natural gas sales to industrial users 1979, 6:16513 (DOE/EIA—0129(79))

NATURAL GAS APPLIANCES
See GAS APPLIANCES

NATURAL GAS DEPOSITS
Electric Logging
Model for the high-frequency electrical response of reservoir rocks and its application to dielectric-log interpretation, 6:16510 (SAND—81-0371C)
Exploitation
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
Exploration
Geochemistry studies in Eastern Kentucky. Final report, 6:16464 (DOE/ET/12138—T3)
Physical and chemical characterization of Devonian gas shale. Quarterly status report, October 1, 1980-December 31, 1980, 6:16509 (MLM-MU—81-53-0002)
Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report, 6:16463 (DOE/ET/12138—T2)
Geopressured Systems
Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)
Hydraulic Fracturing
Laboratory investigation on the effect of in situ stresses on hydraulic fracture containment, 6:16520 (SAND—80-2307C)
Leases
Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)
Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16492 (PB—80-210289)
Alaska OCS socioeconomic studies program. Technical report number 46. Volume 2. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16493 (PB—80-210297)
Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)
Alaska OCS socioeconomic studies program. Technical report number 31. Bering-Norton petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16496 (PB—80-212624)
Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum

development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)
Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report, 6:16497 (PB—80-222482)
Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69, 6:16500 (NP—25371)

Nuclear Magnetic Logging
NMR measurements on Western Gas Sands core, 6:16508 (LA-UR—81-736)
Remote characterization of tight gas sand formations with a new NMR logging tool, 6:16507 (LA-UR—81-735)

Resource Development
Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)

Seismic Surveys
Application of areal seismics to mapping sandstone channels, 6:16511 (SAND—81-0387C)

NATURAL GAS FIELDS

Mineralogy
Strataspecific geochemical trend maps for eastern Kentucky. Appendix to final report, 6:16463 (DOE/ET/12138—T2)

NATURAL GAS INDUSTRY

See also LNG INDUSTRY

Technology Transfer
Foreign industry energy effectiveness. Final report for 1979, 6:17037 (PB—80-210743)

NATURAL GAS WELLS

See also PROPPING AGENTS

Explosive Fracturing
Relationship between photolineaments and Devonian shale gas well productivity; with application to testing of DuPont EL-836 explosive, 6:16517 (DOE/MC/08216—140)
Small-scale experiments with an analysis to evaluate the effect of tailored pulse loading on fracture and permeability. Final report for phase I, June 11, 1979-June 11, 1980, 6:16518 (DOE/MC/11577—T9)

Well Drilling
Geopressured geothermal drilling and completions technology development needs, 6:16743 (SAND—81-0021)

NEBRASKA

Magnetic Surveys
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))

Radiometric Surveys
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))

Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)

NEON

Dimerization
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)

Ion-Atom Collisions
Atomic physics of strongly correlated systems. Progress report, 1 August 1980-31 July 1981, 6:17598 (DOE/ER/10514—12)
Collisional decomposition of UF_6p, 6:17619

NEON 20 REACTIONS

Compound-Nucleus Reactions
Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730

Deep Inelastic Heavy Ion Reactions
Fast-particle emission in the deep-inelastic reaction Cu + ^{20}Ne at 12.6 MeV/nucleon, 6:17711

NEON ISOTOPES

Isotope Separation
Generalized computer model of the transient behavior of multicomponent isotope-separation cascades, 6:16550 (MLM—2816(OP))

NEOPLASMS

See also LYMPHOMAS
MELANOMAS

Transplants
Radiation carcinogenesis. Comprehensive final report, 16 May 1979-31 December 1980, 6:17532 (DOE/EV/03017—43)

NETHERLANDS

Input-Output Analysis
Sectoral economic activity and final energy demand for the EC countries: Belgium/Luxembourg - Federal Republic of Germany - The Netherlands, 6:16912

NEUTRAL BEAM SOURCES

See also ION SOURCES

Research Programs
US negative ion neutral beam development program, 6:17590 (BNL—51304)

Reviews
US negative ion neutral beam development program, 6:17590 (BNL—51304)

NEUTRETTOS

See MUON NEUTRINOS

NEUTRINO DETECTION

Shower Counters
Some results from the charm neutrino experiment at the CERN SPS, 6:17637 (SLAC—239)

NEUTRINO REACTIONS

Deep Inelastic Scattering
Recent results from the CFRR neutrino experiment at Fermilab, 6:17629 (DOE/ER/02232—97)

NEUTRINO-NUCLEON INTERACTIONS

See also ANTINEUTRINO-NUCLEON INTERACTIONS

Cross Sections
Results from the CDHS neutrino experiment, 6:17638 (SLAC—239)

Particle Production
Dimuon production by high energy neutrino and antineutrino nucleon collisions, 6:17647

Total Cross Sections
Recent results from the CFRR neutrino experiment at Fermilab, 6:17636 (SLAC—239)

NEUTRINOS

See also ELECTRON NEUTRINOS
MUON NEUTRINOS

Oscillations
Neutrino instability, 6:17634 (SLAC—239)

NEUTRON DETECTION

Comparative Evaluations
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)

Limiting Values
Statistical and low dose response, 6:17315 (PNL—3536)

Position Sensitive Detectors
Source imaging for FMIT using a neutron pin-hole camera, 6:17275 (DOE/NDC—21/L(Vol.2))

Sensitivity Analysis
Statistical and low dose response, 6:17315 (PNL—3536)

Statistics
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Statistical and low dose response, 6:17315 (PNL—3536)

NEUTRON DETECTORS

See also HE-3 COUNTERS

Personnel Dosimetry
Health physics lead laboratory, 6:17507 (PNL—3700(Pt.5))

Resolution
Importance of resolution for helium detectors used in uranium exploration, 6:16537 (GJBX—38(81))

NEUTRON DOSIMETRY

See also ALBEDO-NEUTRON DOSEMETERS
Review of source characterization for fusion materials irradiations, 6:17274 (DOE/NDC—21/L(Vol.1))

Comparative Evaluations
Extremity dosimeter studies, 6:17314 (PNL—3536)

Energy Dependence
Neutron response study, 6:17308 (PNL—3536)

NEUTRON REACTIONS
Helium generation cross sections for fast neutrons, 6:17707 (DOE/NDC—21/L(Vol.1))

Capture
Dipole radiative strength functions from resonance neutron capture, 6:17739
Neutron-capture cross sections for osmium isotopes and the age of the universe, 6:17721
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Thorium resonance-neutron capture (2.6 to 10 keV), 6:17735 (ORNL/TM—7732)
Charge-Exchange Reactions
Neutron induced charged particle reaction studies at Ohio University (11 MeV), 6:17703 (DOE/NDC—21/L(Vol.1))
Compound-Nucleus Reactions
Cross sections for the reactions of ^{9}Be(n,t$_1\gamma$) and ^{12}C(n,n'γ) between 13.0 and 15.0 MeV, 6:17696 (DOE/NDC—21/L(Vol.1))
Measurement of the angle-integrated secondary neutron spectra from interaction of 14 MeV neutrons with medium and heavy nuclei (17 elements Ti to Bi), 6:17712 (DOE/NDC—21/L(Vol.1))
Status of (n,2n) cross section measurements at Bruyeres-le-Chatel (Threshold to 15 MeV, 50 targets), 6:17718 (DOE/NDC—21/L(Vol.1))
Cross Sections
Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu, 6:17733 (EPRI-NP—1763)
Direct Reactions
Neutron induced charged particle reaction studies at Ohio University (11 MeV), 6:17703 (DOE/NDC—21/L(Vol.1))
Elastic Scattering
Differential scattering cross section measurements above 20 MeV, 6:17695 (DOE/NDC—21/L(Vol.1))
Measured and evaluated bismuth cross sections for fusion-fission hybrid reactors (1.2 to 4.5 MeV), 6:17726 (DOE/NDC—21/L(Vol.2))
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Scattering of 10 MeV neutrons by silicon, 6:17700 (DOE/NDC—21/L(Vol.1))
Fission
Decay of ^{90}Rb/sup g/ and ^{90}Rb/sup m/, 6:17715
Inelastic Scattering
Comparison of experimental and calculated neutron emission spectra and angular distributions (A = 9 to 209), 6:17713 (DOE/NDC—21/L(Vol.2))
Cross sections for the reactions of ^{9}Be(n,t$_1\gamma$) and ^{12}C(n,n'γ) between 13.0 and 15.0 MeV, 6:17696 (DOE/NDC—21/L(Vol.1))
Differential scattering cross section measurements above 20 MeV, 6:17695 (DOE/NDC—21/L(Vol.1))
Investigation of the $^{203, 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
Measured and evaluated bismuth cross sections for fusion-fission hybrid reactors (1.2 to 4.5 MeV), 6:17726 (DOE/NDC—21/L(Vol.2))
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Scattering of 10 MeV neutrons by silicon, 6:17700 (DOE/NDC—21/L(Vol.1))
Information Needs
Differential data including dosimetry reactions, 6:17682 (DOE/NDC—21/L(Vol.1))
FMIT related problems: shielding and materials damage studies, 6:17683 (DOE/NDC—21/L(Vol.1))
Integral Cross Sections
Integral cross section measurements on (n,x) reactions induced by 30 MeV d(Be) break-up neutrons on FRT wall and structural materials, 6:17704 (DOE/NDC—21/L(Vol.2))
Meetings
Symposium on neutron cross-sections from 10 to 50 MeV (BNL, May 12-14, 1980), 6:17681 (DOE/NDC—21/L(Vol.1))
Symposium on neutron cross-sections from 10 to 50 MeV (BNL, May 12-14, 1980), 6:17685 (DOE/NDC—21/L(Vol.2))
Precompound-Nucleus Emission
Comparison of experimental and calculated neutron emission spectra and angular distributions (A = 9 to 209), 6:17713 (DOE/NDC—21/L(Vol.2))
Measurement of the angle-integrated secondary neutron spectra from interaction of 14 MeV neutrons with medium and heavy nuclei (17 elements Ti to Bi), 6:17712 (DOE/NDC—21/L(Vol.1))
Neutron-induced charged particle measurements from carbon, nitrogen, and oxygen at UC, Davis (27.4 to 60.7 MeV), 6:17694 (DOE/NDC—21/L(Vol.1))
Reviews
10 to 50 MeV neutron cross sections: an overview of accomplishments in the context of the 1977 Symposium, 6:17684 (DOE/NDC—21/L(Vol.1))
Secondary Reactions
Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD, 6:17692 (DOE/NDC—21/L(Vol.1))
Spallation
Neutron yields and spectra from 590 MeV (p,n) reactions on lead targets, 6:17725 (DOE/NDC—21/L(Vol.1))
Total Cross Sections
Measured and evaluated bismuth cross sections for fusion-fission hybrid reactors (1.2 to 4.5 MeV), 6:17726 (DOE/NDC—21/L(Vol.2))
Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis (35 to 50 MeV), 6:17702 (DOE/NDC—21/L(Vol.1))
Measurement of neutron-transmission spectra through ^{232}Th from 8 MeV to 4 keV, 6:17734 (ORNL/TM—7661)

NEUTRON SOURCES
(Excludes reactors even when used as neutron sources.)
Comparative Evaluations
Review of source characterization for fusion materials irradiations, 6:17274 (DOE/NDC—21/L(Vol.1))
Neutron Emission
Source imaging for FMIT using a neutron pin-hole camera, 6:17275 (DOE/NDC—21/L(Vol.2))
Neutron Fluence
Characterization of the Be(d,n) neutron field by passive dosimetry techniques, 6:17690 (DOE/NDC—21/L(Vol.1))
Neutron Flux
Review of source characterization for fusion materials irradiations, 6:17274 (DOE/NDC—21/L(Vol.1))
Recommendations
Intense high energy neutron sources and their characteristics, 6:17273 (DOE/NDC—21/L(Vol.1))
Reviews
Intense high energy neutron sources and their characteristics, 6:17273 (DOE/NDC—21/L(Vol.1))
Spatial Dependence
Phantom position dependence, 6:17312 (PNL—3536)

NEUTRON STARS
Collisions
Collisions of asteroids on neutron stars as a cause of cosmic gamma ray bursts, 6:17563
Cosmic Gamma Bursts
Collisions of asteroids on neutron stars as a cause of cosmic gamma ray bursts, 6:17563

NEUTRON-DEFICIENT ISOTOPES
Alpha Decay
Atomic masses for nuclides far from stability, 6:17716

NEUTRON-RICH ISOTOPES
Beta-Minus Decay
Atomic masses for nuclides far from stability, 6:17716

NEUTRONS
See also FAST NEUTRONS
FISSION NEUTRONS
Cross Sections
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Neutron response study, 6:17308 (PNL—3536)
Energy Spectra
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Neutron response study, 6:17308 (PNL—3536)
KeV Range 10-100
Evaluate existing radiation fields, 6:17311 (PNL—3536)
Measuring Methods
Neutron measurements, 6:17745 (SLAC-PUB—2662)

P Invariance
Dipole moments and parity violating spin rotations of the neutron, 6:17742 (SLAC—239)
Spin Orientation
Dipole moments and parity violating spin rotations of the neutron, 6:17742 (SLAC—239)
NEVADA
Electromagnetic Surveys
Electromagnetic (EM-69) survey of the McCoy geothermal prospect, Nevada, 6:16739 (LBL—12012)
Geochemical Surveys
Geochemistry of selected rock samples: Colado geothermal area, Nevada, 6:16735 (DOE/ID/12079—24)
Trace-element geochemistry of gradient hole cuttings: Beowawe geothermal area, Nevada, 6:16734 (DOE/ID/12079—21)
Geophysical Surveys
Geophysical investigations of the Baltazor Hot Springs known geothermal resource area and the Painted Hills thermal area, Humboldt County, Nevada, 6:16736 (DOE/ID/12079—29)
Geothermal Resources
Geophysical investigations of the Baltazor Hot Springs known geothermal resource area and the Painted Hills thermal area, Humboldt County, Nevada, 6:16736 (DOE/ID/12079—29)
Hydrothermal Systems
Geochemistry of selected rock samples: Colado geothermal area, Nevada, 6:16735 (DOE/ID/12079—24)
Resistivity Surveys
Electromagnetic (EM-69) survey of the McCoy geothermal prospect, Nevada, 6:16739 (LBL—12012)
NEVADA TEST SITE
Decontamination
Nevada Operations overview, 6:17405 (CONF-791234—)
Site decontamination, 6:17408 (CONF-791234—)
NEW ENGLAND
See NORTH ATLANTIC REGION
NEW MEXICO
Geochemical Surveys
Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico, 6:16740 (NP—25335)
Geothermal Fields
Seismic exploration for shallow magma bodies in the vicinity of Socorro, New Mexico. Final report, January 1, 1977-December 31, 1977, 6:16741 (NP—25336)
Geothermal Resources
Computer-based chemical and stable isotope modeling of geothermal systems in New Mexico, 6:16740 (NP—25335)
Uranium Deposits
Geology and recognition criteria for uraniferous humate deposits, Grants Uranium Region, New Mexico. Final report, 6:16533 (GJBX—2(81))
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
NEW YORK
See also NEW YORK CITY
Energy Policy
New York State science, engineering and technology program. Phase I. Final report, 6:16916 (PB—80-208648)
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
NEW YORK CITY
Air Pollution
Seasonal variations in light scattering in the New York region and their relation to sources, 6:17349 (BNL—29271)
NICKEL
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)
Corrosion
Electrode-polarization studies in hot-corrosion systems. Progress report, 1 June 1980-31 May 1981, 6:17185 (DOE/ER/02960—T1)
Oxidation
Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report, 6:17097 (DOE/ET/10404—2)
Protective oxide films. Progress report, 6:17117 (DOE/ER/10428—2)
Welded Joints
X-ray diffraction study of residual stress in model weldments. Final report, 6:17109 (UCRL—15332)
NICKEL 58
Giant Resonance
Giant resonance studies with high energy heavy ions, 6:17697 (INKA-Conf—79-001-000)
NICKEL 58 REACTIONS
Fusion Reactions
Recent experiments at the GSI on-line separator, 6:17709
NICKEL 58 TARGET
Neutron Reactions
Neutron induced charged particle reaction studies at Ohio University, 6:17703 (DOE/NDC—21/L(Vol.1))
Nickel 58 Reactions
Recent experiments at the GSI on-line separator, 6:17709
Oxygen 16 Reactions
Giant resonance studies with high energy heavy ions (315 MeV), 6:17697 (INKA-Conf—79-001-000)
NICKEL ALLOYS
See also NICKEL BASE ALLOYS
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)
Corrosion
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Hydridation
Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, May 1, 1980-February 28, 1981 ($LaNi_5$; $LaCo_5$), 6:16599 (DOE/ER/05246—T1)
Magnetization
Magnetization of compositionally modulated CuNi films, 6:17111
Oxidation
Fundamental studies of high-temperature corrosion reactions. Sixth annual progress report (Cu-6% Ni), 6:17097 (DOE/ET/10404—2)
NICKEL BASE ALLOYS
Physical Radiation Effects
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
Segregation
Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981, 6:17094 (DOE/ER/10430—T1)
NICKEL COMPLEXES
Orthorhombic Lattices
Crystal-structure determinations of Lu_3S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)
NICKEL OXIDES
Electron Spin Resonance
Protective oxide films. Progress report, 6:17117 (DOE/ER/10428—2)
Sintering
Advanced fuel-cell development. Progress report, January-March 1980, 6:16946 (ANL—80-67)
NICKEL-HYDROGEN BATTERIES
Cost
Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report, 6:16882 (SAND—80-7191)
Feasibility Studies
Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report, 6:16882 (SAND—80-7191)

Performance
Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report, 6:16882 (SAND—80-7191)

NICKEL-IRON BATTERIES
See IRON-NICKEL BATTERIES

NICKEL-ZINC BATTERIES
Performance
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)
DOE's near-term electric vehicle battery program. Status of improved lead-acid, nickel/iron, and nickel/zinc battery developments, 6:17065 (CONF-800523—4)
Technology Assessment
Development of near-term batteries for electric vehicles. Summary report, October 1977-September 1979, 6:17063 (ANL/OEPM—80-5)

NIOBIUM
Superconductivity
Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb, 6:17749 (DOE/ER/10436—2)
X-Ray Fluorescence Analysis
Direct determination of niobium in uranium-niobium alloys, 6:17161

NIOBIUM 93 REACTIONS
Fusion Reactions
Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)

NIOBIUM ALLOYS
Critical Field
Effect of composition and neutron irradiation on the upper critical field of Nb_3Pt, 6:17135
Electric Conductivity
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Fabrication
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Magnetic Properties
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)
Magnetic Susceptibility
Superconductivity in filamentary eutectic composites. Progress report, June 1, 1980-May 31, 1981, 6:17754 (DOE/ER/04938—T1)
Mechanical Properties
Materials studies for superconducting machinery coil composites. Interim report, 6:17104 (PB—80-212202)
Physical Radiation Effects
Effect of composition and neutron irradiation on the upper critical field of Nb_3Pt, 6:17135
Quantitative Chemical Analysis
Direct determination of niobium in uranium-niobium alloys, 6:17161

NIOBIUM COMPOUNDS
Superconductivity
Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb, 6:17749 (DOE/ER/10436—2)

NIOBIUM NITRIDES
Superconductivity
Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb, 6:17749 (DOE/ER/10436—2)

NIOBIUM SULFIDES
Hexagonal Lattices
Crystal-structure determinations of Lu_3S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)

NITRATES
Bioconversion
Simulation of three-phase fluidized bioreactors for denitrification, 6:16564 (ORNL/MIT—324)
Metabolism
Regulatory coupling of nitrate and sulfate assimilation pathways in cultured tobacco cells, 6:17474
Removal
Simulation of three-phase fluidized bioreactors for denitrification, 6:16564 (ORNL/MIT—324)

NITRIC ACID
Reduction
Feasibility of closed Fe(II)/Fe(III) system for product-reflux in Nitrox process, 6:17165 (DOE/ER/10612—2)

NITRIC OXIDE
Chemical Reactions
Chemical reaction and turbulence. Progress report, June 1, 1980-May 31, 1981 (O_3+NO reaction), 6:17164 (DOE/ER/10439—2)
Photoionization
Molecular beam photoionization study of CO, N_2, and NO dimers and clusters, 6:17612
Quantitative Chemical Analysis
Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978, 6:17203 (PB—80-207970)
Sampling
Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978, 6:17203 (PB—80-207970)

NITRILES
Polarizability
MINDO/3-FP atom-in-molecule polarizabilities of TCNQ, TTF, TMPD, and of their radical ions, 6:17615

NITROGEN
Atom-Molecule Collisions
Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer, 6:17611
Boiling
Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Diffusion
Simultaneous boiling and spreading of liquefied petroleum gas on water. Final report, December 12, 1978-March 31, 1981, 6:16498 (DOE/EV/04548—1)
Neutron Reactions
Neutron-induced charged particle measurements from carbon, nitrogen, and oxygen at UC, Davis (27.4 to 60.7 MeV), 6:17694 (DOE/NDC—21/L(Vol.1))
Photoionization
Molecular beam photoionization study of CO, N_2, and NO dimers and clusters, 6:17612
Production
Energy and materials flows in the production of liquid and gaseous oxygen, 6:16986 (ANL/CNSV—15)
Quantitative Chemical Analysis
Trace detection of N_2 by KrF-laser-excited spontaneous Raman spectroscopy, 6:17159
Solubility
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Solubilities of acid gases and nitrogen in methanol. Final report, September 1979-April 1980, 6:16616 (PB—80-212236)

NITROGEN 13
Radioisotope Scanning
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)

NITROGEN 14
Energy-Level Transitions
Electromagnetic transitions in ^{14}C and ^{14}N, 6:17698
Isotope Separation
Feasibility of closed Fe(II)/Fe(III) system for product-reflux in Nitrox process, 6:17165 (DOE/ER/10612—2)

NITROGEN 15
Isotope Separation
Feasibility of closed Fe(II)/Fe(III) system for product-reflux in Nitrox process, 6:17165 (DOE/ER/10612—2)
Uses
Selected bibliography of biomedical and environmental applications of stable isotopes V-^2H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497

NITROGEN DIOXIDE
Biological Effects
Ecological behavior and effects of energy-related pollutants. Progress report, November 1, 1979-January 31, 1981, 6:17531 (DOE/EV/02412—105)
Quantitative Chemical Analysis
Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978, 6:17203 (PB—80-207970)
Removal
Pessel-AEL flue-gas desulfurization process. Final report, 6:16404 (DOE/IR/06355—T1)
Sampling
Sampling and measuring NO and NO2 in combustion systems. Final report, June 1977-November 1978, 6:17203 (PB—80-207970)
NITROGEN OXIDES
See also NITRIC OXIDE
NITROGEN DIOXIDE
NITROUS OXIDE
Abundance
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
Air Pollution Abatement
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 2. Appendices. Final report, March 1977-May 1978, 6:17244 (PB—80-212939)
Multi-fuel low-NO/sub x/ burner development. Phase I. Final report, November 1978-March 1980, 6:17248 (PB—80-219587)
Air Pollution Control
Environmental assessment of utility boiler combustion modification NO/sub x/ controls: Volume 1. Technical results. Final report, March 1977-May 1978, 6:16801 (PB—80-220957)
Experimental/engineering support for EPA's FBC program: final report. Volume II. Particulate, Nitrogen Oxide, and Trace Element Control. Final report, December 1975-December 1978, 6:16798 (PB—80-219249)
NO/sub x/ control and recovery from products of combustion (Patent), 6:16802
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Materials Recovery
NO/sub x/ control and recovery from products of combustion (Patent), 6:16802
NITROUS OXIDE
Abundance
Scenarios for future anthropogenic emissions of trace gases in the atmosphere, 6:17378 (UCID—18997)
NMR SPECTROMETERS
Design
Simple, fast recovery, low-noise receiver amplifier for pulsed NMR experiments, 6:17334
NOISE THERMOMETERS
Performance
Survey, applications, and prospects of Johnson noise thermometry, 6:17325 (CONF-810437—1)
Specifications
Survey, applications, and prospects of Johnson noise thermometry, 6:17325 (CONF-810437—1)
NONAXIAL NUCLEI
See DEFORMED NUCLEI
NONDESTRUCTIVE TESTING
Standards
Nondestructive examination (supplement to ASME Boiler and Pressure Vessel Code, Section V), 6:16848 (NE-F—3-6T(Rev.)(3-81))
NORTH ATLANTIC REGION
See also MAINE
MASSACHUSETTS
RHODE ISLAND
Interconnected Power Systems
Power pooling in the Northeast Region, 6:16928 (FERC—0050)
NORTH CAROLINA
Peat
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Water Resources
Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina, 6:16622 (FERC—0075)
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)
Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report, 6:16620 (FERC—0073)
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
NORTH DAKOTA
Magnetic Surveys
Aerial radiometric and magnetic survey: MC Clusky National Topographic Map, North Dakota. Final report, 6:16541 (GJBX—84(81))
Aerial radiometric and magnetic survey: McIntosh National Topographic Map, North Dakota/South Dakota. Final report, 6:16543 (GJBX—86(81))
Aerial radiometric and magnetic survey: Bismarck National Topographic Map, North Dakota. Final report, 6:16542 (GJBX—85(81))
Aerial radiometric and magnetic survey: Williston National Topographic Map, North Dakota. Final report, 6:16540 (GJBX—83(81))
Radiometric Surveys
Aerial radiometric and magnetic survey: MC Clusky National Topographic Map, North Dakota. Final report, 6:16541 (GJBX—84(81))
Aerial radiometric and magnetic survey: McIntosh National Topographic Map, North Dakota/South Dakota. Final report, 6:16543 (GJBX—86(81))
Aerial radiometric and magnetic survey: Bismarck National Topographic Map, North Dakota. Final report, 6:16542 (GJBX—85(81))
Aerial radiometric and magnetic survey: Williston National Topographic Map, North Dakota. Final report, 6:16540 (GJBX—83(81))
Wind Power
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)
NORTH SEA
Oil Wells
Evaluation of the potential for EOR using CO_2 in North Sea reservoirs, 6:16477 (CONF-8004140—)
NORTHERN IRELAND
See UNITED KINGDOM
N*RESONANCES
Hadronic Particle Decay
QCD corrections to quarkonia decays, 6:17652 (ANL-HEP-CP—80-60)
Particle Production
Search for exotic meson production at 13 GeV/c in the reaction pi-n → p/sub (forward)/X--, 6:17648
NSLS
Beam Bending Magnets
Inhomogeneities in magnetic field due to variations of lamination gap heights, 6:17253 (BNL—29212)
On-Line Control Systems
Status of the National Synchrotron Light Source control system, 6:17266 (BNL—29208)
Performance
Status of the National Synchrotron Light Source project, 6:17270 (BNL—29242)
Photon Beams
Synchrotron topographic project. Progress report, September 1, 1980-February 20, 1981, 6:17298 (DOE/ER/10740—1)

RF Systems
R.F. cavity design for the NSLS, 6:17269 (BNL—29226)
Rf power systems for the national synchrotron light source, 6:17267 (BNL—29210)
Specifications
Status of the National Synchrotron Light Source project, 6:17270 (BNL—29242)
X-Ray Sources
Synchrotron topographic project. Progress report, September 1, 1980-February 20, 1981, 6:17298 (DOE/ER/10740—1)

NUCLEAR DATA COLLECTIONS
Evaluation
Nuclear model codes and data evaluation, 6:17737 (DOE/NDC—21/L(Vol.1))

NUCLEAR ENERGY
International Agreements
International cooperation in nuclear energy, 6:16907

NUCLEAR EXPLOSIONS
Environmental Effects
Regulatory analysis, 6:17421 (PNL—3700(Pt.5))

NUCLEAR FACILITIES
See also FEED MATERIALS PLANTS
FUEL REPROCESSING PLANTS
Decommissioning
Atomics International's recent decommissioning experience, 6:17415 (CONF-791234—)
Criteria development methodology for DOE decommissioning operations, 6:17418 (CONF-791234—)
DOE decommissioning criteria development, 6:17461 (PNL—3700(Pt.5))
Idaho National Engineering Laboratory decontamination and decommissioning summary, 6:17417 (CONF-791234—)
Decontamination
Cleanup of building 3019 and surroundings at ORNL following plutonium release of November 20, 1959, 6:17411 (CONF-791234—)
FUSRAP equipment concept development study, 6:17419 (CONF-791234—)
Idaho National Engineering Laboratory decontamination and decommissioning summary, 6:17417 (CONF-791234—)
Laboratory-field experience, 6:17407 (CONF-791234—)
New decontamination technologies for environmental applications, 6:16581 (CONF-791234—)
Site decontamination, 6:17408 (CONF-791234—)
Occupational Safety
Statistical health-effects study, 6:17509 (PNL—3700(Pt.5))
Radiation Monitoring
Ground verification of airborne monitor survey, 6:17382 (CONF-791234—)
In situ measurement experiences, 6:17406 (CONF-791234—)
Safety Standards
Health physics lead laboratory, 6:17507 (PNL—3700(Pt.5))

NUCLEAR FUELS
See also FUEL ELEMENTS
FUEL SLURRIES
SPENT FUELS
Environmental Impacts
Analysis of nuclear fuel cycles, 6:17459 (PNL—3700(Pt.5))

NUCLEAR MATTER
Equations of State
Effect of exchange-energy corrections on self-consistent meson masses and on the equation of state of nuclear matter, 6:17740

NUCLEAR MODELS
Computer Codes
Nuclear model codes and data evaluation, 6:17737 (DOE/NDC—21/L(Vol.1))

NUCLEAR PHYSICS
Research Programs
Report to the DOE Nuclear Data Committee (4/80-4/81), 6:17686 (ORNL/TM—7786)

NUCLEAR POWER PLANTS
Inventories
Inventory of power plants in the United States: December 1979, 6:16927 (DOE/EIA—0095(79))
Reactor Accidents
Licensee event report sequence coding and search procedure: a training tool, 6:16863 (CONF-810411—)
Reactor Operation
Licensee event report sequence coding and search procedure: a training tool, 6:16863 (CONF-810411—)
Reactor Operators
Academic involvement in shift technical advisor training for the utilities, 6:16820 (CONF-810411—)
Best nuclear simulator, 6:16815 (CONF-810411—)
College and university programs for meeting the needs of educating nuclear power plant personnel, 6:16817 (CONF-810411—)
Education and training of the shift technical advisor, 6:16818 (CONF-810411—)
Human factors in training, 6:16822 (CONF-810411—)
Job and task analysis: a view from the inside, 6:16821 (CONF-810411—)
Organizing for change: new priorities for training organization in the nuclear industry, 6:16816 (CONF-810411—)
Plant designer's view of the operator's role in nuclear plant safety, 6:16824 (CONF-810411—)
Revision to ANSI/ANS 3.1 1978: resulting from TMI-2, 6:16847 (CONF-810411—)
Shift technical advisors: in the eyes of the NRC, 6:16819 (CONF-810411—)
Towards accurate emergency response behavior, 6:16823 (CONF-810411—)
Training of nuclear facility personnel, 6:16814 (CONF-810411—)
Security
Nuclear security officer training, 6:16825 (CONF-810411—)

NUCLEAR STRUCTURE
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)

NUCLEAR WASTES
See RADIOACTIVE WASTES

NUCLEAR WEAPON TESTS
See NUCLEAR EXPLOSIONS

NUCLEASE (DEOXYRIBONUCLEASE)
See DNA-ASE

NUCLEI
See also DEFORMED NUCLEI
HEAVY NUCLEI
INTERMEDIATE MASS NUCLEI
LIGHT NUCLEI
Energy Levels
New self-consistent approach to the calculations of nuclear energy levels and their lifetime (Stationary phase approximation), 6:17738 (INIS-mf—6088)

NUCLEON ISOBARS
*See N*RESONANCES*

NUCLEONS
See also NEUTRONS
PROTONS
Particle Decay
Review of proton decay experiments, 6:17635 (SLAC—239)
Structure Functions
Results fron CERN muon scattering experiments, 6:17639 (SLAC—239)

NUTS (SEEDS)
See SEEDS

NYMPHS
See LARVAE

O

OAK RIDGE
Aerial Surveying
White Oak Creek Watershed topographic map and related materials, 6:17544 (ORNL/TM—7289)

OAK RIDGE ASSOCIATED UNIVERSITIES
See ORAU

OAK RIDGE NATIONAL LABORATORY
See ORNL

OCEAN THERMAL ENERGY CONVERSION
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Information Needs
Ocean energy researchers information user study, 6:16687 (SERI/TR—751-752)
OCEAN THERMAL POWER PLANTS
Design
Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume A. Detailed report, 6:16684 (JHU/APL-SR—80-1A)
Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume B. Engineering drawings, 6:16685 (JHU/APL-SR—80-1B)
Environmental Impacts
Draft environmental assessment: Ocean Thermal Energy Conversion (OTEC) Pilot Plants, 6:16686 (LBL—12328)
Pilot Plants
Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume A. Detailed report, 6:16684 (JHU/APL-SR—80-1A)
Baseline designs of moored and grazing 40-MW OTEC pilot plants. Volume B. Engineering drawings, 6:16685 (JHU/APL-SR—80-1B)
Draft environmental assessment: Ocean Thermal Energy Conversion (OTEC) Pilot Plants, 6:16686 (LBL—12328)
OCEANS
See SEAS
OCTANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)
OECD
(Organization of Economic Co-operation and Development.)
See also BELGIUM
FEDERAL REPUBLIC OF GERMANY
FINLAND
FRANCE
JAPAN
LUXEMBOURG
NETHERLANDS
SWEDEN
UNITED KINGDOM
USA
Energy Consumption
Energy balances of OECD countries, 1974/1978, 6:16938
Energy Demand
Energy balances of OECD countries, 1974/1978, 6:16938
OFFICE BUILDINGS
Space HVAC Systems
Guide to the energy conservation regulations for new nonresidential buildings, 6:16968 (P—400-80-069)
OFFSHORE PLATFORMS
Materials
European offshore steels research seminar, 6:17242
Meetings
European offshore steels research seminar, 6:17242
OHIO
Magnetic Surveys
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))
Radiometric Surveys
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))
OHMIC RESISTANCE
See ELECTRIC CONDUCTIVITY
OIL SAND INDUSTRY
Technology Assessment
Assessment of international tar sands recovery and upgrading processes, 6:16527 (UCRL—15323)
OIL SANDS
By-Products
Laboratory evaluation of selected tar sand asphalts, 6:16529 (DOE/LC/10049—T1)
Exploitation
Assessment of international tar sands recovery and upgrading processes, 6:16527 (UCRL—15323)
OIL SATURATION
Measurement and correlation of conditions for entrapment and mobilization of residual oil, 6:16470 (CONF-8004140—)
OIL SHALE INDUSTRY
Technology Assessment
Technology assessment, 6:17453 (PNL—3700(Pt.5))
OIL SHALES
See also BLACK SHALES
Certification
A summary of oil shale activities at the National Bureau of Standards 1975-1979. Final report, 6:16530 (PB—80-223126)
In-Situ Retorting
Oil shale research (Characterization; ecology; trace elements; retort abandonment; wastewater treatment), 6:16525 (LBL—11650)
Process for producing shale oil by in-situ electrothermal pyrolysis in a shale deposit (Patent), 6:16528 (SAND—81-6001)
Meetings
A summary of oil shale activities at the National Bureau of Standards 1975-1979. Final report, 6:16530 (PB—80-223126)
Research Programs
Oil shale research (Characterization; ecology; trace elements; retort abandonment; wastewater treatment), 6:16525 (LBL—11650)
Retorting
Oil shale project small retort run summary, Run S-15. Addendum. Computer tables, 6:16526 (UCID—18282(Rev.1))
Standards
A summary of oil shale activities at the National Bureau of Standards 1975-1979. Final report, 6:16530 (PB—80-223126)
OIL SPILL FINGERPRINTING
See OIL SPILLS
OIL SPILLS
Bibliographies
Oil spill removal techniques and equipment. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980, 6:17437 (PB—80-814809)
Biological Effects
Assessment of treated vs untreated oil spills. Final report, 6:16499 (DOE/EV/24047—03)
Environmental Effects
Assessment of treated vs untreated oil spills. Final report, 6:16499 (DOE/EV/24047—03)
Safety Engineering
Oil spills, 6:17438 (PNL—3700(Pt.5))
Water Pollution Abatement
Oil spill removal techniques and equipment. 1976-July 1980 (citations from the NTIS data base). Report for 1976-July 1980, 6:17437 (PB—80-814809)
OIL WELLS
See also PETROLEUM
Carbon Dioxide Injection
Displacement of oil by carbon dioxide, 6:16489 (NP—25370)
Evaluation of the potential for EOR using CO_2 in North Sea reservoirs, 6:16477 (CONF-8004140—)
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)
Weeks Island S Sand Reservoir B gravity stable tertiary CO_2 displacement, Iberia Parish, Louisiana, 6:16476 (CONF-8004140—)
Caustic Flooding
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 1. Body of report, 6:16482 (DOE/ET/12047—52(Vol.1))
Alkaline Waterflooding Demonstration Project, Ranger Zone, Long Beach Unit, Wilmington Field, California. Fourth annual report, June 1979-May 1980. Volume 2. Appendix I, 6:16483 (DOE/ET/12047—52(Vol.2))
Mechanism of oil bank formation, coalescence in porous media and emulsion stability. Annual report, June 1979-May 1980, 6:16480 (DOE/BC/10069—10)

Microemulsion Flooding
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)
Micellar-polymer oil recovery demonstration in the Bell Creek Field, Montana, 6:16479 (CONF-8004140—)
Steam Injection
Scaled physical model studies of the steam drive process. Second annual report, September 1978-September 1979, 6:16486 (DOE/ET/12075—2)
Waterflooding
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)
Mechanism of oil bank formation, coalescence in porous media and emulsion stability. Annual report, June 1979-May 1980, 6:16480 (DOE/BC/10069—10)

OKLAHOMA
Energy Management
Oklahoma Industrial Energy Management Program, 6:17053 (CONF-800483—(Vol.2))

OLEFINS
See ALKENES

ONCOGENIC TRANSFORMATIONS
Biological Effects
Thyroid hormone modulation of x-ray-induced in vitro neoplastic transformation, 6:17519
Radioinduction
Thyroid hormone modulation of x-ray-induced in vitro neoplastic transformation, 6:17519

ONTOGENESIS
Temperature Dependence
Physiological ecology of desert iguana (Dipsosaurus dorsalis) eggs: temperature and water relations, 6:17397

OPEN-CYCLE MHD GENERATORS
Mathematical Models
Technical support for open-cycle MHD program. Progress report, October-December 1979, 6:16940 (ANL/MHD—80-5)

ORAU
(Oak Ridge Associated Universities.)
Oak Ridge Associated Universities, Institute for Energy Analysis research report 1980, 6:16915 (ORAU/IEA—25(1980))

ORBITAL SOLAR POWER PLANTS
Environmental Impacts
Preliminary environmental assessment for the satellite power system (SPS), 6:17541

OREGON
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Network wind power over the Pacific Northwest. Appendix I. Wind power site survey report, 6:16765 (DOE/BP/01310—T1(App.1))
Network wind power over the Pacific Northwest. Wind statistics summaries for the wind power data stations, 6:16766 (DOE/BP/01310—T1(App.2))

ORGAN CULTURES
See TISSUE CULTURES

ORGANIC ACIDS
(Excluding NUCLEIC ACIDS and NUCLEOTIDES.)
Biosynthesis
Liquid fuels production from biomass. Final report, 6:16605 (DOE/ET/20050—T4)
Electrolysis
Liquid fuels production from biomass. Final report, 6:16605 (DOE/ET/20050—T4)

ORGANIC BROMINE COMPOUNDS
See also BROMINATED ALIPHATIC HYDROCARBONS
Radiopharmaceuticals
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
Scintiscanning
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492

ORGANIC COMPOUNDS
See also AMINES
HETEROCYCLIC COMPOUNDS
HYDROCARBONS
KETONES
ORGANIC ACIDS
ORGANIC NITROGEN COMPOUNDS
ORGANIC OXYGEN COMPOUNDS
ORGANIC SULFUR COMPOUNDS
ORGANOMETALLIC COMPOUNDS
PROTEINS
Corrosion
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)
Gas Analysis
Reference method 24-determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings. Reference method 25-determination of total gaseous nonmethane organic emissions as carbon. Background information for promulgated test methods. Final report, 6:17358 (PB—80-209778)
Indoor Air Pollution
Organic contaminants: a bibliography, 6:17356 (LBL—12199)

ORGANIC IODINE COMPOUNDS
See also THYROXINE
Chemical Preparation
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)

ORGANIC MERCURY COMPOUNDS
Comparative Evaluations
Design and synthesis of new radiopharmaceuticals, 6:17194 (DOE/EV/04115—4)

ORGANIC NITROGEN COMPOUNDS
See also ACETAMIDE
AMINES
BARBITURATES
CHLOROPHYLL
DIAZO COMPOUNDS
GUANIDINES
MELANIN
NITRILES
PHENOBARBITAL
PORPHYRINS
PROTEINS
PYRIMIDINES
Molecular Structure
Nitrogenous substances and means of studying the molecular structure of fuels, 6:16401 (ORNL-tr—4725)
Polarizability
MINDO/3-FP atom-in-molecule polarizabilities of TCNQ, TTF, TMPD, and of their radical ions, 6:17615

ORGANIC OXYGEN COMPOUNDS
See also BARBITURATES
KETONES
ORGANIC ACIDS
PHENOBARBITAL
QUINONES
Chemical Analysis
Application of selected chemical reactions to the organic chemistry of coal (Ms thesis; 146 references), 6:16397 (IS-T—948)
Chemical Reactions
Application of selected chemical reactions to the organic chemistry of coal (Ms thesis; 146 references), 6:16397 (IS-T—948)
Cobalt carbene ion: reactions of Co^+ with C_2H_4, cyclo-C_3H_6, and cyclo-C_2H_4O, 6:17618
Photolysis
Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO (Diazabicyclooctane), 6:17188
Reduction
Cage escape and spin rephasing of triplet ion-radical pairs: temperature - viscosity and magnetic field effects in photoreduction of fluorenone by DABCO (Diazabicyclooctane), 6:17188

ORGANIC SULFUR COMPOUNDS
See also SULFONATES
SULFONES
THIOCYANATES
Chemical Analysis
Application of selected chemical reactions to the organic chemistry of coal (Ms thesis; 146 references), 6:16397 (IS-T—948)

Chemical Reactions
Application of selected chemical reactions to the organic chemistry of coal (Ms thesis; 146 references), 6:16397 (IS-T—948)
Polarizability
MINDO/3-FP atom-in-molecule polarizabilities of TCNQ, TTF, TMPD, and of their radical ions, 6:17615

ORGANOMETALLIC COMPOUNDS
See also ORGANIC MERCURY COMPOUNDS
Design
Electrolyte properties for photoelectrochemical cells with emphasis on the molecular adaptation of metallocenes: a review, 6:16663
Electrochemistry
Electrolyte properties for photoelectrochemical cells with emphasis on the molecular adaptation of metallocenes: a review, 6:16663
Meetings
Fourth symposium on macrocyclic compounds, 6:17177 (DOE/ER/10605—4)

ORNL
(Oak Ridge National Laboratory.)
Aerial Surveying
White Oak Creek Watershed topographic map and related materials, 6:17544 (ORNL/TM—7289)
Radiation Accidents
Cleanup of building 3019 and surroundings at ORNL following plutonium release of November 20, 1959, 6:17411 (CONF-791234—)
Research Programs
Report to the DOE Nuclear Data Committee (4/80-4/81), 6:17686 (ORNL/TM—7786)
Topography
White Oak Creek Watershed topographic map and related materials, 6:17544 (ORNL/TM—7289)

OSMIUM 191
Diagnostic Uses
Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4)
Toxicity
Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4)

OSMIUM ISOTOPES
Neutron Reactions
Neutron-capture cross sections for osmium isotopes and the age of the universe, 6:17721

OUTER CONTINENTAL SHELF
See CONTINENTAL SHELF

OVERBURDEN
Chemical Analysis
Avoiding contamination of overburden drill samples, 6:16422
Contamination
Avoiding contamination of overburden drill samples, 6:16422
Sampling
Avoiding contamination of overburden drill samples, 6:16422

OXYGEN
Atom-Molecule Collisions
Bimolecular and "three-body" quenching of Paschen-1s argon atoms by N_2, H_2, and O_2 and effects of N_2 on the yield of the first triplet argon excimer, 6:17611
Chemical Reactions
Mechanism of the H + O_3 reaction, 6:17155
Study of the ion—molecule half reactions O+2(a 4Pi/sub u/, v)xxx(O_2)/sub m/→O+/sub 2m/+1+O, m=1, 2, or 3, using the molecular beam photoionization method, 6:17170
Theoretical characterization of the potential energy curve for hydrogen atom addition to molecular oxygen, 6:17616
Neutron Reactions
Measurements of neutron total and total nonelastic cross sections for C, O, Ca, and Fe at UC Davis (35 to 50 MeV), 6:17702 (DOE/NDC—21/L(Vol.1))
Neutron-induced charged particle measurements from carbon, nitrogen, and oxygen at UC, Davis (27.4 to 60.7 MeV), 6:17694 (DOE/NDC—21/L(Vol.1))
Predissociation
MQDT analysis of predissociation. I. A two channel problem with semiclassical scattering parameters, 6:17620
Production
Energy and materials flows in the production of liquid and gaseous oxygen, 6:16986 (ANL/CNSV—15)

OXYGEN 16
Excitation Functions
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)

OXYGEN 16 REACTIONS
Inelastic Scattering
Giant resonance studies with high energy heavy ions (315 MeV), 6:17697 (INKA-Conf—79-001-000)

OXYGEN 16 TARGET
Neutron Reactions
Differential scattering cross section measurements above 20 MeV, 6:17695 (DOE/NDC—21/L(Vol.1))
Niobium 93 Reactions
Light-particle and gamma-ray emission measurements in heavy-ion reactions. Progress report, June 1, 1980-May 30, 1981, 6:17699 (DOE/ER/10418—T1)

OXYGEN 18
Uses
Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497

OXYGEN EFFECT (RADIOBIOLOGY)
See OXYGEN

OXYGEN IONS
Chemical Reactions
Study of the ion—molecule half reactions O+Z(a 4Pi/sub u/, v)xxx(O_2)/sub m/→O+/sub 2m/+1+O, m=1, 2, or 3, using the molecular beam photoionization method, 6:17170
Photoionization
Study of the ion—molecule half reactions O+2(a 4Pi/sub u/, v)xxx(O_2)/sub m/→O+/sub 2m/+1+O, m=1, 2, or 3, using the molecular beam photoionization method, 6:17170

OXYMETHYLENE
See FORMALDEHYDE

OZONE
Chemical Reactions
Chemical reaction and turbulence. Progress report, June 1, 1980-May 31, 1981 (O_3/NO reaction), 6:17164 (DOE/ER/10439—2)
Electronic Structure
Large multiconfiguration self-consistent-field wave functions for the ozone molecule, 6:17613

P

P INVARIANCE
Proton-Nucleon Interactions
Search for parity non-conservation polarized proton-nucleon scattering at 6 GeV/c, 6:17650

PACIFIC NORTHWEST REGION
See also ALASKA
IDAHO
OREGON
WASHINGTON
Interconnected Power Systems
Power pooling in the Western Region, 6:16931 (FERC—0054)
Wind Power
Network wind power over the Pacific Northwest. Progress report, October 1978-September 1979, 6:16764 (DOE/BP/01310—T1)

PAKISTAN
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)

PALLADIUM COMPLEXES
Monoclinic Lattices
Crystal-structure determinations of Lu_3S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)

PANCREAS
Radioisotope Scanning
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)
PARABOLIC TROUGH COLLECTORS
Performance
1980 annual report of the Coolidge Solar Irrigation Project, 6:16679 (SAND—80-2378)
Solar production of industrial process steam. Phase III. Operation and evaluation of the Johnson and Johnson solar facility. Final report, January 1, 1980-March 31, 1981, 6:16694 (DOE/CS/31713—T1)
Performance Testing
Midtemperature Solar Systems Test Facility predictions for thermal performance based on test data: Custom Engineering trough with glass reflector surface and Sandia-designed receivers, 6:16716 (SAND—80-1964/10)
PARITY NONCONSERVATION
See P INVARIANCE
PARTICLE DECAY
See also HADRONIC PARTICLE DECAY
CP Invariance
Phenomenology of CP violation from the Kobayashi-Maskawa model, 6:17669 (BNL—29074)
Neutrino Detection
Review of proton decay experiments, 6:17635 (SLAC—239)
PARTICLE IDENTIFICATION
Time-of-Flight Method
Time-of-flight measurements, 6:17320 (SLAC—239)
PARTICLES
See also DROPLETS
Deposition
Particulate deposition from turbulent parallel streams, 6:17624 (ANL/MHD—81-2)
Deposits
Particulate deposition from turbulent parallel streams, 6:17624 (ANL/MHD—81-2)
Environmental Impacts
Environmental assessment data systems user guide: Fine Particle Emissions Information System. Final report, September 1978-September 1979, 6:17905 (PB—80-222433)
Fragmentation
Means and method for the destruction of particles entrained in a gas stream (Patent), 6:16791
PASSIVE SOLAR HEATING SYSTEMS
See also DIRECT GAIN SYSTEMS
TROMBE WALLS
Retrofitting
Investigation of the potential application of solar energy to existing homes. Semi-annual technical progress report, 6:16709 (DOE/R5/10235—1)
PATIENTS
Medical Surveillance
Aggregation of deaths from ischaemic heart disease among first and second degree relatives of 108 males and 42 females with myocardial infarction, 6:17501
Radiation Doses
Observed detector characteristics in mammography: suggestions for further studies, 6:17496
PDX DEVICES
Research Programs
Annual report, October 1, 1978-September 30, 1979, 6:17880 (PPPL-Q—37)
PEACH BOTTOM-3 REACTOR
Acoustic Monitoring
Investigation into continuous acoustic emission monitoring of BWR components. Semi-annual report, 6:16828 (DOE/ET/34216—T2)
PEAT
Anaerobic Digestion
Peat biogasification, 6:16613 (TR—80/031-001)
Carbonization
Peat pretreatment: high-pressure wet carbonization, 6:16608 (TR—80/031-001)
Energy Source Development
Evaluation of environmental issues on the use of peat as an energy source, 6:16417 (TR—80/031-001)
Exploration
Ground penetrating radar demonstration/evaluation in Minnesota, 6:16421 (TR—80/031-001)
Fluidization
Peat gasification: IGT work progress, 6:16607 (TR—80/031-001)
Gasification
Comparative analysis of peat gasification reactor configurations, 6:17906 (TR—80/031-001)
Modeling in peat gasification, 6:16612 (TR—80/031-001)
Peat gasification: IGT work progress, 6:16607 (TR—80/031-001)
Peat gasification: low-severity hydropyrolysis, 6:16610 (TR—80/031-001)
Peat gasification: Rockwell International process, 6:16611 (TR—80/031-001)
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Meetings
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Pyrolysis
Peat gasification: low-severity hydropyrolysis, 6:16610 (TR—80/031-001)
Research Programs
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Resource Assessment
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Resource Development
Evaluation of environmental issues on the use of peat as an energy source, 6:16417 (TR—80/031-001)
Socioeconomic issues associated with the use of peat as an energy resource, 6:17449 (TR—80/031-001)
Water Removal
Peat dewatering: solvent extraction, 6:16609 (TR—80/031-001)
PENETROMETERS
Design
Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980, 6:16428 (DOE/TIC—11445)
PENNING ION SOURCES
Beam Extraction
Characteristics of a modified duoPIGatron negative ion source, 6:17583 (BNL—51304)
Performance
Characteristics of a modified duoPIGatron negative ion source, 6:17583 (BNL—51304)
PENTAERYTHRITOL TETRANITRATE
See PETN
PENTANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Viscosity
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
2,4-PENTANEDIONE
See ACETYLACETONE
PENTANOLS
Partition
Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study, 6:17191
PEOPLES REPUBLIC OF CHINA
See CHINA
PEP STORAGE RINGS
(Positron-electron-proton storage ring.)
Specifications
PEP, 6:17302 (SLAC—239)

PERFUSED ORGANS
Scintiscanning
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4)
PERMEABILITY
Computerized Simulation
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
PERSONNEL
See also RADIOLOGICAL PERSONNEL
Education
Nuclear security officer training, 6:16825 (CONF-810411—)
Productivity
Labor productivity in heavy construction: impact on synfuels program employment, 6:17447 (ANL/AA—24)
Radiation Protection
Apparatus and method for downhole injection of radioactive tracer (Patent), 6:17324
Training
Use of a conversational computer program in operator training for improved energy efficiency, 6:17025 (CONF-800483—(Vol.2))
PERSONNEL DOSIMETRY
See also BETA DOSIMETRY
NEUTRON DOSIMETRY
Information Needs
Personnel dosimetry calibrations, 6:17506 (PNL—3700(Pt.5))
Sensitivity Analysis
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
PETN
(Pentaerythritol tetranitrate.)
Recrystallization
Study of PETN/LX-13 from semi-continuous recrystallized Mil. Spec. PETN, 6:17336 (MHSMP—81-08)
PETRA STORAGE RING
Performance
Highlights from PETRA experiments, 6:17304 (SLAC—239)
Research Programs
Highlights from PETRA experiments, 6:17304 (SLAC—239)
PETROCHEMICAL PLANTS
Energy Audits
Comprehensive energy audit of a large production unit in six weeks, 6:16993 (CONF-800483—(Vol.2))
PETROLEUM
See also OIL WELLS
SHALE OIL
Phase Studies
Phase behavior of CO_2 and crude oil in low temperature reservoirs, 6:16478 (CONF-8004140—)
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Viscosity
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Scaled physical model studies of the steam drive process. Second annual report, September 1978-September 1979, 6:16486 (DOE/ET/12075—2)
PETROLEUM DEPOSITS
Exploitation
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
Forecasting
China report: economic affairs, No. 110, 6:16895 (JPRS—77198)
Leases
Alaska OCS socioeconomic studies program. Technical report number 45. Lower Cook Inlet petroleum development scenarios transportation systems analysis. Final report, 6:16503 (PB—80-210271)
Alaska OCS socieconomic studies program. Technical report number 46. Volume 1. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16492 (PB—80-210289)
Alaska OCS socioeconomic studies program. Technical report number 46. Volume 2. Lower Cook Inlet petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16493 (PB—80-210297)
Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Alaska OCS socioeconomic studies program. Technical report number 44. Lower Cook Inlet petroleum development scenarios: commercial fishing industry analysis. Final report, 6:16495 (PB—80-212475)
Alaska OCS socioeconomic studies program. Technical report number 31. Bering-Norton petroleum development scenarios local socioeconomic systems analysis. Final report, 6:16496 (PB—80-212624)
Alaska OCS socioeconomic studies program. Technical report number 54, Volume 1. Bering-Nortonorton petroleum development scenarios sociocultural systems analysis. Final report, 6:16504 (PB—80-219264)
Alaska OCS socioeconomic studies program. Technical report number 50. Bering-Norton petroleum development scenarios: economic and demographic analysis. Final report, 6:16497 (PB—80-222482)
Draft environmental impact statement: proposed OCS oil and gas sales 67 and 69, 6:16500 (NP—25371)
PETROLEUM REFINERIES
See also DISTILLATION EQUIPMENT
Energy Efficiency
Use of a conversational computer program in operator training for improved energy efficiency, 6:17025 (CONF-800483—(Vol.2))
Processing
Role of the FLEXICOKING process in heavy-oil processing, 6:16490 (CONF-800483—(Vol.2))
Solar Process Heat
High-temperature process-steam application at the Southern Union Refining Company, Hobbs, New Mexico (solar energy in the oil patch). Phase I design. Final report, 6:16695 (DOE/CS/32223—T1)
Waste Disposal
Assessment of land treatment technology for petroleum refinery solid wastes, 6:16501 (PB—80-220593)
PETROLEUM SULFONATES
Adsorption
Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—)
Electric Conductivity
Aggregation of sodium alkylbenzenesulfonates in aqueous solution, 6:16465 (CONF-810308—11)
Solubility
Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—)
Viscosity
Aggregation of sodium alkylbenzenesulfonates in aqueous solution, 6:16465 (CONF-810308—11)
PHANTOMS
Shielding
Neutron response study, 6:17308 (PNL—3536)
Spatial Dependence
Phantom position dependence, 6:17312 (PNL—3536)
PHASE CHANGE MATERIALS
Thermal Conduction
Modeling of phase-change processes with time-varying critical temperature, 6:16880 (ORNL/CSD/TM—145)
PHENOBARBITAL
Biological Effects
Phenobarbital effects on weight gain and circadian cycling of food intake and body temperature, 6:17536
PHENYLETHYLENE
See STYRENE
PHI-1019 RESONANCES
Pair Production
Upper limits on phiphi production in 350-GeV/c proton-beryllium collisions, 6:17643
PHOSPHATE GLASS
Fabrication
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)

Fracture Properties
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
Microstructure
Phosphate glass ceramics: formation, properties, and applications, 6:17124 (SAND—80-2613C)
PHOSPHATES
Hydrolysis
Influence of temperature on nonenzymatic hydrolysis of p-nitrophenyl phosphate in soil, 6:17396
PHOSPHORUS 31
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
PHOSPHORUS 32
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
PHOSPHORYLASES
See PHOSPHOTRANSFERASES
PHOSPHOTRANSFERASES
Enzyme Activity
Tissue enzyme changes in parabiotic rats with subcutaneous lymphoma, 6:17469 (DOE/EV/03017—T1)
Temperature Effects
Role of SRC gene in growth regulation of Rous sarcoma virus-infected chicken embryo fibroblasts, 6:17486
PHOTOCHEMISTRY
Reaction Intermediates
Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay, 6:17468 (DOE/ER/04927—T3)
Research Programs
Multiphoton dissociation spectroscopy and photochemistry. Progress report, July 15, 1980-March 15, 1981, 6:17187 (DOE/ER/10660—1)
Radiation Laboratory, University of Notre Dame. Quarterly report, October 1, 1980-December 31, 1980, 6:17189 (DOE/ER/00038—2210)
PHOTODISINTEGRATION
See PHOTONUCLEAR REACTIONS
PHOTOELECTROCHEMICAL CELLS
Electrolytes
Electrolyte properties for photoelectrochemical cells with emphasis on the molecular adaptation of metallocenes: a review, 6:16663
PHOTON DETECTION (GAMMA)
See GAMMA DETECTION
PHOTON-ION COLLISIONS
Electron Detachment
Laser neutralization of negative ion beams for fusion, 6:17591 (BNL—51304)
Measurement of H^- and D^- density in plasma by photodetachment, 6:17574 (BNL—51304)
PHOTONS
Calibration
High energy photon response, 6:17309 (PNL—3536)
Energy Spectra
Evaluate existing radiation fields, 6:17311 (PNL—3536)
KeV Range 10-100
Beta and low energy photon response, 6:17310 (PNL—3536)
Strength Functions
Dipole radiative strength functions from resonance neutron capture, 6:17739
Thermoluminescent Dosimetry
Beta and low energy photon response, 6:17310 (PNL—3536)
High energy photon response, 6:17309 (PNL—3536)
PHOTONUCLEAR REACTIONS
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Delbrueck Scattering
Test of vacuum polarization by precise investigation of Delbrueck scattering, 6:17710
Elastic Scattering
Test of vacuum polarization by precise investigation of Delbrueck scattering, 6:17710
PHOTOPERIOD
Recording Systems
Simple light-level recording device to monitor lighting in animal quarters, 6:17505
PHOTOSYNTHESIS
Biochemical Reaction Kinetics
Hydrogen formation in nearly stoichiometric amounts from glucose by a Rhodopseudomonas sphaeroides mutant, 6:17479
Photosynthesis: the light reactions, 6:17485
Biological Pathways
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)
Biomimetic Processes
Electron transfer in systems of well-defined geometry, 6:17186 (DOE/ER/10392—4)
PHOTOSYNTHETIC MEMBRANES
Biochemistry
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)
Pigments
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)
Proteins
Structural relationship in chloroplast membranes. Final report, August 1, 1977-August 31, 1980, 6:16639 (DOE/ER/04475—2)
PHOTOVOLTAIC CELLS
See also SOLAR CELLS
Health Hazards
Estimates of occupational safety and health impacts resulting from large-scale production of major photovoltaic technologies, 6:16631 (BNL—51324)
Manufacturing
Estimates of occupational safety and health impacts resulting from large-scale production of major photovoltaic technologies, 6:16631 (BNL—51324)
Occupational Safety
Estimates of occupational safety and health impacts resulting from large-scale production of major photovoltaic technologies, 6:16631 (BNL—51324)
Semiconductor Materials
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
Specifications
Assessment of nickel-hydrogen batteries for terrestrial solar applications. Final report, 6:16882 (SAND—80-7191)
PHOTOVOLTAIC CONVERSION
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
PHOTOVOLTAIC POWER SUPPLIES
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Demonstration Programs
Solar photovoltaic residence in Carlisle, Massachusetts, 6:16671 (DOE/ET/20279—129)
Electric Batteries
Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
Residential solar-photovoltaic power systems: the need for battery storage, 6:16667 (CONF-800567—5)
Field Tests
Reliability of terrestrial photovoltaic modules at various DOE/MIT Lincoln Laboratory Test Sites, 6:16670 (DOE/ET/20279—126)
Three-year performance study of the Mead, Nebraska, 25-kWp photovoltaic power system, 6:16669 (DOE/ET/20279—122)
Performance
Heat pumps and utility-interactive photovoltaic power systems, 6:16668 (DOE/ET/20279—120)

Redox Fuel Cells
Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
Uses
Photovoltaics: solar electric power systems, 6:16675 (SERI/SP—433-487)
PHYSICAL RADIATION EFFECTS
Mathematical Models
Impact of advanced microstructural characterization techniques on modeling and analysis of radiation damage, 6:17100 (HEDL-SA—1936)
PHYSICS
See also HIGH ENERGY PHYSICS
NUCLEAR PHYSICS
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)
PHYTOPLANKTON
See also DIATOMS
Food Chains
Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981, 6:17429 (DOE/EV/00639—22)
PIG ION SOURCES
See PENNING ION SOURCES
PILES
See FOUNDATIONS
PINNING FORCE
See MAGNETIC FLUX
PINS (FUEL)
See FUEL PINS
PION MINUS REACTIONS
Particle Production
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
PION MINUS-PROTON INTERACTIONS
Cross Sections
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
Yields
Measurement of the decay rate of the Dalitz decay of the neutral pion, 6:17649
PION PLUS REACTIONS
Particle Production
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
PION PLUS-PROTON INTERACTIONS
Cross Sections
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
PION REACTIONS
Resonance Scattering
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
PION-NEUTRON INTERACTIONS
Missing-Mass Spectra
Search for exotic meson production at 13 GeV/c in the reaction pi-n → p/sub (forward)/X--, 6:17648
PION-NUCLEON INTERACTIONS
See also PION-NEUTRON INTERACTIONS
Partial Waves
Pion-nucleon partial wave analysis and study of baryon structure. Progress report, June 1, 1979-May 31, 1981, 6:17655 (DOE/ER/10402—T1)
PION-PION INTERACTIONS
S Matrix
Solution of the unitarity equation with overlapping left and right cuts: a tool for study of the S* and similar systems, 6:17680
PIONS
See also PIONS NEUTRAL
Particle Production
Single and double pion production from 800 MeV proton-proton collisions, 6:17644
PIONS NEUTRAL
Radiative Decay
Measurement of the decay rate of the Dalitz decay of the neutral pion, 6:17649
PIPELINE QUALITY GAS
See HIGH BTU GAS
PIPELINES
See also SLURRY PIPELINES
Cost
Piping networks for district heating applications, 6:17049
PIPES
Turbulent Flow
Particulate deposition from turbulent parallel streams, 6:17624 (ANL/MHD—81-2)
PLANT CELLS
Sensitivity
Regulatory coupling of nitrate and sulfate assimilation pathways in cultured tobacco cells, 6:17474
PLANTS
See also EUPHORBIA
TREES
Aquatic Ecosystems
Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb, 6:17439
Reproduction
Ecological behavior and effects of energy-related pollutants. Progress report, November 1, 1979-January 31, 1981, 6:17531 (DOE/EV/02412—105)
PLANTS (INDUSTRIAL)
See INDUSTRIAL PLANTS
PLANTS (POWER)
See POWER PLANTS
PLASMA
See also COLLISIONLESS PLASMA
HIGH-BETA PLASMA
INHOMOGENEOUS PLASMA
LASER-PRODUCED PLASMA
Absorption
Classical anomalous absorption in strongly magnetized plasmas and effective shielding length, 6:17814
Computer Codes
Plasma physics plotting package, 6:17763 (LA—8161-M)
Electric Conductivity
Classical anomalous absorption in strongly magnetized plasmas and effective shielding length, 6:17814
Electron-Ion Collisions
Inelastic electron-ion scattering in a dense plasma, 6:17798 (PPPL—1776)
Fokker-Planck Equation
FPPAC: a two-dimensional multispecies nonlinear Fokker-Planck package, 6:17802 (UCRL—85666)
Gravitational Fields
Toroidal plasma equilibrium with gravity, 6:17808
Hydrogen Ions 1 Minus
H^- and D^- production in plasma, 6:17575 (BNL—51304)
Impurities
Control of impurities in toroidal plasma devices (Patent), 6:17888
Ion Density
H^- and D^- production in plasma, 6:17575 (BNL—51304)
Magnetohydrodynamics
Statistical theory of magnetohydrodynamic turbulence, 6:17809
Orbits
Constants of motion in a helical magnetic field, 6:17811
Relaxation
Relaxation of toroidal discharges, 6:17783 (PPPL—1755)
Rotation
Plasma rotation in field-reversed theta pinches, 6:17793 (PPPL—1755)
Transport Theory
Classical anomalous absorption in strongly magnetized plasmas and effective shielding length, 6:17814
Turbulence
Statistical theory of magnetohydrodynamic turbulence, 6:17809
PLASMA (BLOOD)
See BLOOD PLASMA

PLASMA CONFINEMENT
See also INERTIAL CONFINEMENT
Analytical Solution
Omnigenous equilibria, 6:17799 (SAI—254-81-102-LJ)
Radiowave Radiation
Radio frequency flux control of toroidal plasmas, 6:17795 (PPPL—1755)
PLASMA DIAGNOSTICS
Far Infrared Radiation
CW far-infrared laser-scattering apparatus for plasma wave studies, 6:17812
Interferometers
Two-wavelength HeNe laser interferometer, 6:17801 (UCID—18988)
Laser Radiation
CW far-infrared laser-scattering apparatus for plasma wave studies, 6:17812
Lasers as a tool for plasma diagnostics, 6:17768 (LA-UR—81-896)
Streak Photography
Pulsed versus direct current calibration of a proximity focused x-ray streak camera, 6:17764 (LA—8425-MS)
PLASMA GUNS
Formation of a compact torus using a toroidal plasma gun, 6:17778 (PPPL—1755)
Magnetized gun experiments, 6:17777 (PPPL—1755)
Operation
Field-reversed gun based on the inverse-pinch discharge, 6:17859 (PPPL—1755)
Initial results of field reversed plasma gun experiment, 6:17845 (PPPL—1755)
PLASMA HEATING
See also HIGH-FREQUENCY HEATING
Alpha Particles
Radio frequency current drive in fusioning plasma, 6:17761 (GA-A—16194)
Plasma Waves
Effect of resonance broadening on the evolution of the edge of a turbulent spectrum, 6:17806
Travelling Waves
Current generation by minority-species heating, 6:17816
PLASMA INSTABILITY
See also PLASMA MACROINSTABILITIES
Plasma Heating
Singular solutions and the continuous spectrum, 6:17810
Spectra
Singular solutions and the continuous spectrum, 6:17810
PLASMA MACROINSTABILITIES
See also BALLOONING INSTABILITY
KINK INSTABILITY
TEARING INSTABILITY
Periodic field-reversed equilibria for a multiple-cell linear theta pinch, 6:17791 (PPPL—1755)
Tilting mode in the reversed-field theta pinch, 6:17790 (PPPL—1755)
Instability Growth Rates
Calculation of ideal MHD growth rates and eigenfunctions in field reversed mirrors in the large toroidal mode number limit, 6:17781 (PPPL—1755)
PLASMA SIMULATION
Field Equations
Global method of solving the electron-field equations in a zero-inertia-electron-hybrid plasma simulation code, 6:17823
PLASMA WAVES
See also ION ACOUSTIC WAVES
Nonlinear Problems
Effect of resonance broadening on the evolution of the edge of a turbulent spectrum, 6:17806
Resonance
Effect of resonance broadening on the evolution of the edge of a turbulent spectrum, 6:17806
PLATINUM
Catalytic Effects
Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)
Corrosion
Stability of acid-fuel-cell cathode materials. Work period: January 1, 1978-December 31, 1979, 6:16950 (EPRI-EM—1664)
PLATINUM 194 TARGET
Triton Reactions
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
PLATINUM 195
Antineoplastic Drugs
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
PLATINUM 196
Energy Levels
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
PLATINUM 196 TARGET
Triton Reactions
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
PLATINUM 198
Energy Levels
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
PLATINUM 198 TARGET
Triton Reactions
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
PLATINUM 200
Energy Levels
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
PLATINUM ALLOYS
Critical Field
Effect of composition and neutron irradiation on the upper critical field of Nb_3Pt, 6:17135
Physical Radiation Effects
Effect of composition and neutron irradiation on the upper critical field of Nb_3Pt, 6:17135
PLATINUM COMPOUNDS
Antineoplastic Drugs
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
PLT DEVICES
(Princeton Large Torus.)
Energy Losses
Radiation losses in PLT during neutral beam and ICRF heating experiments, 6:17797 (PPPL—1768)
ICR Heating
Fast-wave ion-cyclotron heating in the Princeton Large Torus, 6:17774 (PPPL—1729)
Neutral Atom Beam Injection
Fusion neutron production during deuterium neutral-beam injection into the PLT tokamak, 6:17819
Neutron Emission
Fusion neutron production during deuterium neutral-beam injection into the PLT tokamak, 6:17819
Research Programs
Annual report, October 1, 1978-September 30, 1979, 6:17880 (PPPL-Q—37)
Thermonuclear Reactions
Observation of d-^{3}He fusion reactions in a tokamak plasma, 6:17688
PLUMES
Mathematical Models
Studies on mathematical models for characterizing plume and drift behavior from cooling towers. Executive summary, 6:17351 (EPRI-CS—1683-SY)

PLUTONIUM
Deposition
Calculation of particulate dispersion in a design-basis tornadic storm from the Battelle Memorial Institute, Columbus, Ohio, 6:17383 (DP—1583)
Diffusion
Calculation of particulate dispersion in a design-basis tornadic storm from the Battelle Memorial Institute, Columbus, Ohio, 6:17383 (DP—1583)
Radiation Accidents
Cleanup of building 3019 and surroundings at ORNL following plutonium release of November 20, 1959, 6:17411 (CONF-791234—)
Radioecological Concentration
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
Radionuclide Migration
Calculation of particulate dispersion in a design-basis tornadic storm from the Battelle Memorial Institute, Columbus, Ohio, 6:17383 (DP—1583)
Valence
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)
PLUTONIUM 237
Environmental Transport
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
Sorption
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
PLUTONIUM 238
Radiation Monitoring
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
Radioecological Concentration
Annual environmental monitoring report: Calendar Year 1980, 6:17441 (MLM—2822)
PLUTONIUM 239
Decontamination
Soil decontamination at Rocky Flats Plant, 6:17410 (CONF-791234—)
Environmental Transport
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
Fission
Fission reaction in high energy proton cascade, 6:17731 (DOE/NDC—21/L(Vol.1))
Radiation Monitoring
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
Radioecological Concentration
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
Sorption
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
PLUTONIUM 239 TARGET
Neutron Reactions
Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu, 6:17733 (EPRI-NP—1763)
PLUTONIUM 240
Radiation Monitoring
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
Radioecological Concentration
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
PLUTONIUM 241 TARGET
Neutron Reactions
Evaluation of the thermal cross sections of ^{239}Pu and ^{241}Pu, 6:17733 (EPRI-NP—1763)
PLUTONIUM OXIDES
Radioecological Concentration
Cleanup of building 3019 and surroundings at ORNL following plutonium release of November 20, 1959, 6:17411 (CONF-791234—)
PNA
See POLYCYCLIC AROMATIC HYDROCARBONS
PNEUMOCONIOSES
Bibliographies
Black lung benefits program: selected references. Bibliography report, 1970-79, 6:16461 (PB—80-207988)
POINT MUTATIONS
See GENE MUTATIONS
POLAND
Research Programs
East Europe report: scientific affairs, No. 694, 6:17559 (JPRS—77389)
POLARIZED BEAMS
Beam Dynamics
Acceleration of polarized protons in the Brookhaven AGS, 6:17255 (BNL—29295)
POLLUTION CONTROL
See also AIR POLLUTION CONTROL
WATER POLLUTION CONTROL
Quality Assurance
Environmental protection support, 6:17462 (PNL—3700(Pt.5))
Technology Assessment
Analysis of fusion fuel cycles, 6:17460 (PNL—3700(Pt.5))
POLLUTION CONTROL EQUIPMENT
See also AFTERBURNERS
CATALYTIC CONVERTERS
SCRUBBERS
Desulfurization
EPA utility FGD survey: January-March 1980. Quarterly report, 6:16796 (PB—80-211832)
Operating Cost
Demonstration of carbon adsorption technology for petroleum dry cleaning plants. Final report, October 1977-April 1979, 6:16502 (PB—80-221039)
Performance
Demonstration of carbon adsorption technology for petroleum dry cleaning plants. Final report, October 1977-April 1979, 6:16502 (PB—80-221039)
Performance Testing
Evaluation of the Ethyl lean reactor system applied to a Dodge Coronet. Technical report, 6:17059 (PB—80-210305)
Reviews
EPA utility FGD survey: January-March 1980. Quarterly report, 6:16796 (PB—80-211832)
Testing
Durability demonstration of systems for control of sulfuric acid. Final report, November 1976-September 1979, 6:17360 (PB—80-212129)
POLLUTION REGULATIONS
Economic Impact
Economic impact of implementing RACT (reasonably available control technology) guidelines in the state of Kentucky. Final report, 6:17388 (PB—80-206980)
Program to prevent the significant deterioration of carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead. Interim report, 6:17394 (PB—80-221260)
Regulatory impact assessment for the September 5, 1979 proposed regulations for prevention of significant deterioration, 6:17392 (PB—80-220734)
Environmental Impacts
Impact of proposed and alternative 'de minimis' levels for criteria pollutants, 6:17393 (PB—80-221229)
Program to prevent the significant deterioration of carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead. Interim report, 6:17394 (PB—80-221260)
Regulatory impact assessment for the September 5, 1979 proposed regulations for prevention of significant deterioration, 6:17392 (PB—80-220734)
Implementation
Economic impact of implementing RACT (reasonably available control technology) guidelines in the state of Kentucky. Final report, 6:17388 (PB—80-206980)

Program to prevent the significant deterioration of carbon monoxide, ozone, hydrocarbons, nitrogen dioxide, and lead. Interim report, 6:17394 (PB—80-221260)

POLONIUM 199
Decay
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)

POLONIUM 201
Decay
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)

POLORIDAL DIVERTOR EXPERIMENT
See PDX DEVICES

POLYCYCLIC AROMATIC HYDROCARBONS
Fluorescence Spectroscopy
Recent developments in the analysis of air samples by luminescence techniques, 6:17350 (CONF-810346—1)
Toxicity
Mutagenicity of soot and associated polycyclic aromatic hydrocarbons to Salmonella typhimurium, 6:17537

POLYENES
Radiolysis
Interfacial electron transfer involving radical ions of carotene and diphenylhexatriene in micelles and vesicles, 6:17190

POLYESTERS
See also MYLAR
Dielectric Properties
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Mechanical Properties
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)

POLYETHERS
See POLYETHYLENE GLYCOLS

POLYETHYLENE GLYCOLS
Biological Effects
Effects of polyethylene glycol on reverse transcriptase and other polymerase activities, 6:17476

POLYETHYLENES
Cross-Linking
Effects of processing conditions on the reliability of cross-linked polyethylene cable insulation. Progress report, 6:17130 (DOE/ER/10421—T1)

POLYMER FLOODING
See MICROEMULSION FLOODING

POLYMERASES
Sensitivity
Effects of polyethylene glycol on reverse transcriptase and other polymerase activities, 6:17476

POLYMERS
See also SILICONES
Corrosion
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)
Deposition
Hydrocarbon plasma emission as a means to monitor plasma polymerization, 6:17131 (SAND—81-0806C)
Thermal Degradation
Geothermal fracture stimulation technology. Volume III. Geothermal fracture fluids, 6:16751 (DOE/AL/10563—T8(Vol.3))

POLYNUCLEAR HYDROCARBONS
See CONDENSED AROMATICS

POLYPROPYLENE
Annealing
Annealing of polypropylene films crystallized from a highly extended melt, 6:17134
Microstructure
Annealing of polypropylene films crystallized from a highly extended melt, 6:17134

POLYURETHANES
Application of structure-property relationships to develop seven segmented polyurethane adhesives, 6:17133 (UCRL—84039)

POLYVINYLS
Physical Radiation Effects
Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)

PONDS
See LAKES

POPULATION DYNAMICS
Biological Models
Evolution of mutualism between species, 6:17395 (CONF-800160—1)

POROSITY
Computerized Simulation
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)

POROUS MATERIALS
Wettability
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)

PORPHYRINS
See also CHLOROPHYLL
Electronic Structure
Axial ligand effects on iron and manganese porphyrins: extended Hueckel calculations of Cyt P450 analogs and of O_2 binding to iron and manganese, 6:17162
Photochemistry
Electron transfer in systems of well-defined geometry, 6:17186 (DOE/ER/10392—4)

POSITION SENSITIVE DETECTORS
Evaluation
Phantom position dependence, 6:17312 (PNL—3536)

POSITRON COMPUTED TOMOGRAPHY
Images
Imaging properties of a positron tomograph with 280 BGO crystals, 6:17491 (LBL—11858)

POTASSIUM
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)

POTASSIUM ALLOYS
Catalytic Effects
Investigation of dispersed iron alloy catalysts in the carbon monoxide-hydrogen synthesis reaction. Progress report, August 1, 1980-July 31, 1981, 6:17089 (DOE/ER/04993—T1)

POTASSIUM CHLORIDES
Crystal Defects
High-temperature properties and processes in ceramics: thermomigration. Annual report, January 1, 1980-December 31, 1980, 6:17119 (DOE/ER/02923—4)
Polarizability
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)

POTASSIUM FLUORIDES
Polarizability
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)

POTASSIUM NITRATES
Corrosive Effects
Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)

POTENTIAL SCATTERING
Phase Shift
Variable phase method for the calculation of the scattering phase shift: the bound-state region, 6:17758

POULTRY
See FOWL

POWDERS
Chemical Composition
Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9), 6:16571 (UCID—18845)

Chemical Preparation
Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9), 6:16571 (UCID—18845)
Wet chemical method for the production of synthetic raw materials and homogeneous powders for physical-chemical studies, 6:17167 (IS-Trans—111)

POWER CONDITIONING CIRCUITS
Data Compilation
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))
Manufacturers
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))

POWER DEMAND
Forecasting
Approach to market-penetration analysis for advanced electric-power-generation technologies, 6:16926 (BNL—51285)
Automatic load forecasting. Final report, 6:16910 (EPRI-EL—1758)

POWER GENERATION
See also COGENERATION
Risk Assessment
Comparative health and safety assessment of alternative future electrical-generation systems, 6:17451 (CONF-800567—6)
Technology Assessment
Approach to market-penetration analysis for advanced electric-power-generation technologies, 6:16926 (BNL—51285)

POWER PLANT AND INDUSTRIAL FUEL USE ACT
Implementation
Powerplant and Industrial Fuel Use Act annual report, 6:16913 (DOE/RG—0057)

POWER PLANTS
See also DUAL-PURPOSE POWER PLANTS
HYDROELECTRIC POWER PLANTS
THERMAL POWER PLANTS
WIND POWER PLANTS
Control Systems
Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2))
Energy Management
Control-system design for effective energy utilization: a case study, 6:17017 (CONF-800483—(Vol.2))
Environmental Impacts
Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station (Analysis of impacts of thermal discharge on Maumee Bay and analysis of impact of entrainment and impingement on fish communities), 6:17524 (PNL—3409)

POWER POOLS
See INTERCONNECTED POWER SYSTEMS

POWER REACTORS
See also EBR-2 REACTOR
PEACH BOTTOM-3 REACTOR
PRAIRIE ISLAND-1 REACTOR
PRAIRIE ISLAND-2 REACTOR
PROCESS HEAT REACTORS
SUMMER-1 REACTOR
THREE MILE ISLAND-2 REACTOR
Reactor Safety
Reporter at large: Three Mile Island. II. The paper trail, 6:16875

POWER SUBSTATIONS
Data Acquisition Systems
Real-Time Digital Data-Acquisition System for determining load characteristics. Volume 2. Operating, programming, and maintenance instructions. Final report, 6:16808 (EPRI-EL—851(Vol.2))
Load Analysis
Real-Time Digital Data-Acquisition System for determining load characteristics. Volume 2. Operating, programming, and maintenance instructions. Final report, 6:16808 (EPRI-EL—851(Vol.2))

POWER SYSTEMS
See also AC SYSTEMS
INTERCONNECTED POWER SYSTEMS
Electrical Transients
Determination of synchronous-machine-stability study constants. Final report, 6:16787 (EPRI-EL—1424(Vol.2))
Load Analysis
Automatic load forecasting. Final report, 6:16910 (EPRI-EL—1758)
Turbogenerators
Determination of synchronous-machine-stability study constants. Final report, 6:16787 (EPRI-EL—1424(Vol.2))

POWER TRANSMISSION LINES
Electric Fields
Electric fields under power lines (supplement to 'an examination of electric fields under ehv (extra-high-voltage) overhead power transmission lines'). Final report, 6:16813 (PB—80-222474)
Project resumes: biological effects from electric fields associated with high-voltage transmission lines, 6:17538 (CONF-801187—(Absts.))
Superconducting Cables
LASL Nb_3Ge conductor development. Sixteenth quarterly progress report, April 1-June 30, 1980, 6:16812 (LA—8606-PR)

POWER TRANSMISSION TOWERS
Materials
Composite wood utility poles. Final report, 6:16810 (EPRI-EL—1745)

PRAIRIE ISLAND-1 REACTOR
Environmental Impacts
Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)

PRAIRIE ISLAND-2 REACTOR
Environmental Impacts
Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)

PRECIPITATIONS (ATMOSPHERIC)
See ATMOSPHERIC PRECIPITATIONS

PRESSURE VESSELS
Fracture Mechanics
Development of a plastic fracture methodology. Final report, 6:16849 (EPRI-NP—1734)
Nondestructive Testing
Nondestructive examination (supplement to ASME Boiler and Pressure Vessel Code, Section V), 6:16848 (NE-F—3-6T(Rev.)(3-81))

PRESSURIZED WATER REACTORS
See PWR TYPE REACTORS

PRIMARY COOLANT CIRCUITS
Acoustic Monitoring
Experimental study of advanced continuous acoustic emission monitoring of BWR components. Final report, 6:16827 (DOE/ET/34216—T1)
Radioactivity Transport
US/FRG Umbrella Agreement for Cooperation in GCR Development: fuel, fission products and graphite subprogram. Quarterly status report, January 1, 1981-March 31, 1981, 6:16836 (GA-A—16283)

PRINCE EDWARD ISLAND
Industrial Plants
Energy audits on Prince Edward Island (ENERSAVE program), 6:16994 (CONF-800483—(Vol.2))

PRINCETON LARGE TORUS
See PLT DEVICES

PRINTED CIRCUITS
Fabrication
Etchback smear removal process characterization. Final report, 6:17237 (BDX—613-2598)
Research Programs
Electronics Engineering Department. Quarterly report No. 3, 1980, 6:17238 (UCRL—50025-80-3)

PROCESS HEAT
See also SOLAR PROCESS HEAT
Applications of fusion thermal energy to industrial processes, 6:17829 (CONF-801210—24)

Feasibility Studies
Laser fusion systems for industrial process heat. Final report, 6:17834 (DOE/TIC—11435(Vol.1))
Laser fusion systems for industrial process heat. Final report, 6:17835 (DOE/TIC—11435(Vol.2))
Hot Water
Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2))
PROCESS HEAT REACTORS
Design
HTGR process heat program: design and analysis. Final report, FY-80 (1170 MW(t)), 6:16835 (GA-A—16217)
Feasibility Studies
High-temperature gas-cooled reactor: reformer application study, 6:16834 (DOE/SF/02034—T10)
Reactor Materials
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
PROCESSING
Energy Conservation
Practical approach to process analysis and improvement for energy conservation, 6:17026 (CONF-800483—(Vol.2))
PROCESSING (WASTES)
See WASTE PROCESSING
PRODUCER GAS
Corrosive Effects
Ceramic corrosion/erosion project description, 6:16368 (DOE/METC/SP—111)
PRODUCTION (HYDROGEN)
See HYDROGEN PRODUCTION
PROGRAMMING
Recommendations
Standards and procedures for INTERACT, 6:17892 (CONF-810431—1)
PROJECT (VELA)
See VELA PROJECT
PROJECTILES
Propulsion
Rail gun program, 6:17208 (LA—8669-MS)
PROJECTION SPARK CHAMBERS
Electron Drift
Particle identification by energy loss measurement and long drift imaging chambers, 6:17317 (SLAC—239)
Reviews
Particle identification by energy loss measurement and long drift imaging chambers, 6:17317 (SLAC—239)
PROMETHAZINE
See AMINES
PROPANE
Phase Studies
Evaluation of high pressure vapor-liquid equilibrium for the binary systems containing CO_2 and C_1 to C_{10} paraffins, 6:16474 (CONF-8004140—)
PROPANONE
See ACETONE
PROPPING AGENTS
Geothermal fracture stimulation technology. Volume 1. Fracturing proppants and their properties, 6:16749 (DOE/AL/10563—T8(Vol.1))
Crushing
Geothermal fracture stimulation technology. Volume IV. Proppant analysis at geothermal conditions, 6:16752 (DOE/AL/10563—T8(Vol.4))
Performance Testing
Geothermal fracture stimulation technology. Volume II. High-temperature proppant testing, 6:16750 (DOE/AL/10563—T8(Vol.2))
Thermal Degradation
Geothermal fracture stimulation technology. Volume IV. Proppant analysis at geothermal conditions, 6:16752 (DOE/AL/10563—T8(Vol.4))
PROTECTION (RADIATION)
See RADIATION PROTECTION
PROTEINS
See also ACTIN
HISTONES
METALLOTHIONEIN
Metabolism
Immunoreactive helix-destabilizing protein localized in transcriptionally active regions of Drosophila polytene chromosomes, 6:17487
PROTON BEAMS
Acceleration
Formation and propagation of a proton ring, 6:17813
Beam Currents
Los Alamos proton-storage-ring extraction system, 6:17259 (LA-UR—81-784)
Rotation
Formation and propagation of a proton ring, 6:17813
PROTON REACTIONS
Charge-Exchange Reactions
Low energy neutron emission from Be(d,n) and Be(p,n) reactions (10 to 25 MeV), 6:17691 (DOE/NDC—21/L(Vol.1))
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Elastic Scattering
Deuteron D-wave and the non-eikonal effects in tensor asymmetries in elastic proton-deuteron scattering, 6:17687
Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr (Analysis by optical and collective DWBA), 6:17706
Neutron physics research at Triangle Universities Nuclear Laboratory, 6:17693 (DOE/NDC—21/L(Vol.1))
Nuclear-structure studies with pions and heavy ions. Progress report, June 1, 1980-May 31, 1981, 6:17560 (DOE/ER/10423—T2)
Single and double pion production from 800 MeV proton-proton collisions, 6:17644
Spin rotation and depolarization in the ^2H(p vector,p vector)^2H reaction and the double-spin-flip part of the NN amplitude, 6:17689
Fission
Fission reaction in high energy proton cascade (300 MeV), 6:17731 (DOE/NDC—21/L(Vol.1))
Inelastic Scattering
Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr (Analysis by optical and collective DWBA), 6:17706
Pair Production
Upper limits on phiphi production in 350-GeV/c proton-beryllium collisions, 6:17643
Particle Production
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
Secondary Reactions
Neutron yields and spectra from 590 MeV (p,n) reactions on lead targets, 6:17725 (DOE/NDC—21/L(Vol.1))
Spallation
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
Neutron yields and spectra from 590 MeV (p,n) reactions on lead targets, 6:17725 (DOE/NDC—21/L(Vol.1))
PROTON-ANTIPROTON INTERACTIONS
Charmed Baryon Resonances
High energy physics annual report, January 1, 1979-December 31, 1979, 6:17642 (UCR—34P107-263)
PROTON-NUCLEON INTERACTIONS
See also PROTON-PROTON INTERACTIONS
Total Cross Sections
Search for parity non-conservation polarized proton-nucleon scattering at 6 GeV/c, 6:17650
PROTON-PROTON INTERACTIONS
Cross Sections
Study of hadronic jets produced by charged pion and proton beams incident on hydrogen and aluminum targets (200 GeV), 6:17646
Elastic Scattering
Single and double pion production from 800 MeV proton-proton collisions, 6:17644

PROTONS
Absorption
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
Semileptonic Decay
Proton decay rate, 6:17668
Three-body decays of the proton, 6:17664
PROTOPLASTS
See PLANT CELLS
PSI RESONANCES
Leptonic Decay
QCD corrections to quarkonia decays, 6:17652 (ANL-HEP-CP—80-60)
Particle Decay
Brief review of recent results from the crystal ball detector at SPEAR, 6:17633 (SLAC—239)
Photoproduction
Inelastic photoproduction of J/psi and Y by gluons, 6:17663
Second-order quantum-chromodynamic effect in J/psi photoproduction, 6:17662
PSYCHOSES
See MENTAL DISORDERS
PUBLIC BUILDINGS
See also SHOPPING CENTERS
Space HVAC Systems
Guide to the energy conservation regulations for new nonresidential buildings, 6:16968 (P—400-80-069)
PUBLIC LANDS
Environmental Quality
Changes in public land management required to achieve Congressional expectations. Executive summary. Report to the Congress, 6:16898 (PB—80-210180)
Resource Development
Changes in public land management required to achieve Congressional expectations. Executive summary. Report to the Congress, 6:16898 (PB—80-210180)
PUBLIC UTILITIES
See also ELECTRIC UTILITIES
Data Base Management
Quarterly project status report, January-March 1981, 6:16914 (DOE/RG/10367—T2)
Regulations
Quarterly project status report, January-March 1981, 6:16914 (DOE/RG/10367—T2)
Steam Generation
Statistical committee report of industry statistics for 1979, 6:17038
PUERTO RICO
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
PULPS
See SLURRIES
PUMPS
See also SOLAR WATER PUMPS
WIND-POWERED PUMPS
Energy Efficiency
Energy-saving pumping systems in chemical plant design, 6:17028 (CONF-800483—(Vol.2))
PWR TYPE REACTORS
See also PRAIRIE ISLAND-1 REACTOR
PRAIRIE ISLAND-2 REACTOR
SUMMER-1 REACTOR
THREE MILE ISLAND-2 REACTOR
Annular Fuel Elements
Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers, 6:16829 (GEAP—24310)
Core Flooding Systems
Measurement of transient two-phase flow velocity using statistical signal analysis of impedance probe signals, 6:17225 (CONF-810434—2(Draft))
ECCS
Graphic display of spatially distributed binary-state experimental data, 6:16861 (CONF-810235—1)
Flowmeters
Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
Fuel Rods
Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Ice Condensers
Review of proposed improvements, including filter/vent of BWR pressure-suppression and PWR ice containments. Final report, 6:16871 (EPRI-NP—1747)
Loss of Coolant
Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)
Graphic display of spatially distributed binary-state experimental data, 6:16861 (CONF-810235—1)
Reactor Instrumentation
Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
Reactor Internals
Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers, 6:16829 (GEAP—24310)
Reactor Safety
Light water reactor safety technology program. Quarterly report, October-December 1980, 6:16874 (SAND—81-0473)
Steam Generators
Situ corrosion monitoring of steam generators, 6:16832
PYRIMIDINES
See also BARBITURATES
Photoreactivation
Photoreactivation of pyrimidine dimers in DNA from thyroid cells of the teleost, Poecilia formosa, 6:17522
PYRITE
Desulfurization
Pyrite desulfurization by wet oxidation in alkaline solutions, 6:16392
Leaching
Desulfurization of coal by microbiological leaching. Final report, September 1, 1978-June 1, 1980, 6:16381 (NP—25377)
PYROLYSIS
Solar Process Heat
Flash pyrolysis of coal through solar heating, 6:16378 (LA-UR—81-764)

Q

QUANTUM CHROMODYNAMICS
Perturbation Theory
Seven topics in perturbative QCD, 6:17677 (FERMILAB-CONF—80/79-THY)
Photoproduction
Second-order quantum-chromodynamic effect in J/psi photoproduction, 6:17662
Renormalization
Quark masses and renormalization-scheme dependence in quantum chromodynamics, 6:17666
QUANTUM ELECTRODYNAMICS
Electron-Positron Interactions
Bremsstrahlung process in electron positron colliding beams, 6:17651
QUANTUM FIELD THEORY
See also QUANTUM CHROMODYNAMICS
QUANTUM ELECTRODYNAMICS
Conservation Laws
Exact integrability in quantum field theory and statistical systems, 6:17678

Tunnel Effect
Tunneling decay of unstable particles in a quantum field theoretic model, 6:17679
Two-Dimensional Calculations
Exact integrability in quantum field theory and statistical systems, 6:17678
QUARK MODEL
See also FLAVOR MODEL
Weak Particle Decay
Weak decays of strange and heavy quarks, 6:17660 (SLAC—239)
QUARKONIUM
Bound State
Heavy quarks and new particles, 6:17674 (DOE/ER/01764—382)
Quantum Chromodynamics
Heavy quarks and new particles, 6:17674 (DOE/ER/01764—382)
QUARKS
Decay
Two-jet decay of particles with heavy quarks, 6:17665
Fragmentation
How to calculate the heavy-quark fragmentation function: an application of cut vertices, 6:17667
Mass
From the standard model to composite quarks and leptons. Part I. Standard model, its present status and its open problems. Part II. Composite quarks and leptons, 6:17661 (SLAC—239)
Quark masses and renormalization-scheme dependence in quantum chromodynamics, 6:17666
Recombination
Study of different forms for the recombination function in the formation of mesons from partons, 6:17657 (IS-T—929)
QUARTZ
Wettability
Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs (Surfactants - carboxymethylized oxyethylate, naphthenic acid betaine, alkylsulfonate), 6:16472 (CONF-8004140—)
Measurement of contact angles at room and reservoir conditions, 6:16468 (CONF-8004140—)
QUINONES
Electron Transfer
Environmental effects on electron transfer from chlorophyll triplet to quinone: role of dielectric constant, viscosity and quinone structure in cellulose acetate films, 6:16640 (DOE/ER/04927—T4)
Photochemistry
Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay, 6:17468 (DOE/ER/04927—T3)

R

RADAR
Testing
Ground penetrating radar demonstration/evaluation in Minnesota, 6:16421 (TR—80/031-001)
RADIANT HEAT TRANSFER
Calculation Methods
Combustion air preheat should be more than supply recycling energy, 6:17003 (CONF-800483—(Vol.2))
RADIATION ACCIDENTS
Fault Tree Analysis
Analysis of criticality safety, 6:17508 (PNL—3700(Pt.5))
RADIATION CHEMISTRY
Research Programs
Radiation Laboratory, University of Notre Dame. Quarterly report, October 1, 1980-December 31, 1980, 6:17189 (DOE/ER/00038—2210)
RADIATION DECONTAMINATION
See DECONTAMINATION
RADIATION DOSEMETERS
See DOSEMETERS
RADIATION HAZARDS
Radiation Protection
Laboratory-field experience, 6:17407 (CONF-791234—)
RADIATION HYGIENE
See RADIATION PROTECTION
RADIATION MONITORING
Technology Assessment
Environmental decontamination, 6:17401 (CONF-791234—)
RADIATION PROTECTION
Safety Engineering
Health physics lead laboratory, 6:17507 (PNL—3700(Pt.5))
RADIATION SAFETY
See RADIATION PROTECTION
RADICALS
See also ARYL RADICALS
Decay
Chlorophyll-quinone photochemistry in liposomes: mechanisms of radical formation and decay, 6:17468 (DOE/ER/04927—T3)
Polarizability
INDO and MINDO/3 atom-in-molecule polarizabilities, 6:17614
RADIOACTIVE AEROSOLS
Lung Clearance
Tracheobronchial clearance studies in the guinea pig, 6:17513 (UR—3490-1981)
RADIOACTIVE BIOLOGICAL WASTES
See RADIOACTIVE WASTES
RADIOACTIVE EFFLUENTS
See also RADIOACTIVE WASTES
Environmental Exposure Pathway
Atmospheric release advisory capability, 6:17381 (CONF-791234—)
Monitoring
Handbooks on effluent and environmental monitoring, 6:17385 (PNL—3700(Pt.5))
RADIOACTIVE MATERIALS
See also FISSION PRODUCTS
RADIOACTIVE WASTES
RADIOPHARMACEUTICALS
Remote Handling
Design guides for radioactive-material-handling facilities and equipment, 6:17206 (HEDL-SA—2191)
RADIOACTIVE PARTICULATES
See PARTICLES
RADIOACTIVE WASTE DISPOSAL
Casks
Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
Geologic Deposits
Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980, 6:16568 (RHO-BWI—80-100-4Q)
Nuclear waste repository in basalt. Project B-301: functional design criteria, 6:16569 (RHO-BWI-CD—38(Rev.3))
NWTS program criteria for mined geologic disposal of nuclear wasite: site performance criteria, 6:16560 (DOE/NWTS—33(2))
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Hazards
Nuclear waste disposal facility intrusion: an archeologist's perspective, 6:16561 (LA-UR—81-830)
High-Level Radioactive Wastes
Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980, 6:16568 (RHO-BWI—80-100-4Q)
Research and development on ultimate storage of radioactive wastes. Annual report, 1977, 6:16558 (ORNL-tr—4740)
Intermediate-Level Radioactive Wastes
Research and development on ultimate storage of radioactive wastes. Annual report, 1977, 6:16558 (ORNL-tr—4740)
Liquid Wastes
Calculations on heat generation in the storage and solidification of MLW/LLW in large-capacity caverns (Reference systems A and B of the in-situ project), 6:16575 (ORNL-tr—4739)

Low-Level Radioactive Wastes
Research and development on ultimate storage of radioactive wastes. Annual report, 1977, 6:16558 (ORNL-tr—4740)
Research Programs
Research and development on ultimate storage of radioactive wastes. Annual report, 1977, 6:16558 (ORNL-tr—4740)
Safety Standards
Surface soil contamination standards for Rockwell Hanford Operations, 6:17412 (CONF-791234—)
Salt Deposits
Creep of 50-mm diameter specimens of dome salt from Avery Island, Louisiana, 6:17552 (ONWI—104)
Research and development on ultimate storage of radioactive wastes. Annual report, 1977, 6:16558 (ORNL-tr—4740)
Site Selection
NWTS program criteria for mined geologic disposal of nuclear wasite: site performance criteria, 6:16560 (DOE/NWTS—33(2))
Spent Fuels
Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980, 6:16568 (RHO-BWI—80-100-4Q)
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Temperature Measurement
Calculations on heat generation in the storage and solidification of MLW/LLW in large-capacity caverns (Reference systems A and B of the in-situ project), 6:16575 (ORNL-tr—4739)
Underground Disposal
Preliminary investigation of the thermal and structural influence of crushed-salt backfill on repository disposal rooms, 6:16562 (ONWI—138)

RADIOACTIVE WASTE FACILITIES
Backfilling
Preliminary investigation of the thermal and structural influence of crushed-salt backfill on repository disposal rooms, 6:16562 (ONWI—138)
Design
Basalt Waste Isolation Project. Quarterly report, July 1, 1980-September 30, 1980, 6:16568 (RHO-BWI—80-100-4Q)
Nuclear waste repository in basalt. Project B-301: functional design criteria, 6:16569 (RHO-BWI-CD—38(Rev.3))
Technical conservatisms in NWTS repository conceptual designs. National Waste Terminal Storage Repository No. 1: special study No. 4, 6:16563 (ONWI—222)
Radiation Hazards
Radiological health review of the Final Environmental Impact Statement Waste Isolation Pilot Plant. Volumes 1 and 2. DOE/EIS-0026, 6:16582 (DOE/AL/10752—10)
Site Selection
Site selection criteria for the shallow land burial of low-level radioactive waste, 6:16576 (EGG-WM—5393)

RADIOACTIVE WASTE MANAGEMENT
See also RADIOACTIVE WASTE STORAGE
Low-Level Radioactive Wastes
Low-level radioactive biomedical wastes, 6:16577 (UR—3490-1978)

RADIOACTIVE WASTE PROCESSING
Solidification
Application of SYNROC to high-level defense wastes, 6:16572 (UCRL—85032)
Method for immobilizing radioactive iodine (Patent), 6:16574
Thermal conductivity of multibarrier waste form components, 6:16566 (PNL—3090)

RADIOACTIVE WASTE STORAGE
High-Level Radioactive Wastes
Technical conservatisms in NWTS repository conceptual designs. National Waste Terminal Storage Repository No. 1: special study No. 4, 6:16563 (ONWI—222)
Radionuclide Migration
Potential influence of organic compounds on the transport of radionuclides from a geologic repository. Assessment of effectiveness of geologic isolation systems, 6:16580 (PNL—3414)
Salt Deposits
Technical conservatisms in NWTS repository conceptual designs. National Waste Terminal Storage Repository No. 1: special study No. 4, 6:16563 (ONWI—222)

RADIOACTIVE WASTES
See also CALCINED WASTES
HIGH-LEVEL RADIOACTIVE WASTES
RADIOACTIVE EFFLUENTS
Environmental Transport
AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)
Leaching
Time and temperature dependence of the leaching of a simulated high-level waste glass, 6:16567 (PNL-SA—9054)
Slagging Pyrolysis Process
Waste incineration, 6:16559 (CONF-791234—)

RADIOACTIVITY
Maximum Permissible Body Burden
Surface soil contamination standards for Rockwell Hanford Operations, 6:17412 (CONF-791234—)

RADIOCARBON DATING
See CARBON 14

RADIOCARDIOGRAPHY
Research Programs
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)

RADIOCOLLOIDS
Cell Killing
Astatine-211-tellurium radiocolloid cures experimental malignant ascites, 6:17514

RADIOGRAPHY (BIOMEDICAL)
See BIOMEDICAL RADIOGRAPHY

RADIOISOTOPE GENERATORS
Evaluation
Development and clinical application of the Os-191 → Ir-191m generator, 6:17490 (DOE/EV/04115—4)
Research Programs
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)

RADIOISOTOPE HEAT SOURCES
Research Programs
Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for October-December 1980, 6:16591 (PNL—1845-49)

RADIOISOTOPE MIGRATION
See RADIONUCLIDE MIGRATION

RADIOISOTOPE SCANNING
See also SCINTISCANNING
Research Programs
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)

RADIOISOTOPES
See also ALPHA DECAY RADIOISOTOPES
NEUTRON-DEFICIENT ISOTOPES
NEUTRON-RICH ISOTOPES
Internal Irradiation
Comparison of 50-year and 70-year internal-dose-conversion factors, 6:17744 (ORNL/TM—7415)
Measuring Instruments
Laboratory-field experience, 6:17407 (CONF-791234—)
Measuring Methods
Cryogenic method for measuring nuclides and fission gases (Patent), 6:17323
Nuclear Materials Management
Radioisotope customer list, 6:17510 (PNL—3700(Pt.5))

RADIOLOGICAL PERSONNEL
Epidemiology
Statistical health-effects study, 6:17509 (PNL—3700(Pt.5))

RADIOMETRIC SURVEYS
Data Analysis
Geostatistics project of the National Uranium Resource Evaluation program. Progress report, April-September 1980, 6:16548 (GJBX—99(81))

Statistical techniques applied to aerial radiometric surveys (STAARS): principal components analysis user's manual (NURE program), 6:16534 (GJBX—9(81))

RADIONUCLIDE CONCENTRATION
See RADIOACTIVITY

RADIONUCLIDE MIGRATION
(In environment.)
Potential influence of organic compounds on the transport of radionuclides from a geologic repository. Assessment of effectiveness of geologic isolation systems, 6:16580 (PNL—3414)
Mathematical Models
FEMWASTE: a Finite-Element Model of Waste transport through porous saturated-unsaturated media, 6:16579 (ORNL—5601)

RADIONUCLIDES
See RADIOISOTOPES

RADIOPHARMACEUTICALS
Biochemical Reaction Kinetics
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Biological Accumulation
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
Chemical Preparation
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4)
Design and synthesis of new radiopharmaceuticals, 6:17194 (DOE/EV/04115—4)
Development and therapeutic application of internally emitting radiopharmaceuticals, 6:17197 (DOE/EV/04115—4)
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Comparative Evaluations
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
Evaluation
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)
Performance Testing
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
Purification
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Research Programs
Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1979-February 28, 1981 (Lead abstract), 6:17192 (DOE/EV/04115—4)
Scintiscanning
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
Tissue Distribution
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

RADIOSURGERY
See RADIOTHERAPY

RADIOTHERAPY
Muon Beams
Beam characteristics in the LAMPF biomedical channel, 6:17281 (LA-UR—81-805)
Planning
Beam characteristics in the LAMPF biomedical channel, 6:17281 (LA-UR—81-805)
Radiocolloids
Astatine-211-tellurium radiocolloid cures experimental malignant ascites, 6:17514

RADON 206
Energy Levels
Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730
High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report, 6:17723 (DOE/ER/10434—2)

RADON 208
Energy Levels
Electron capture and positron decay of ^{206}Fr and ^{208}Fr and the energy levels of ^{206}Rn and ^{208}Rn, 6:17730
High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report, 6:17723 (DOE/ER/10434—2)

RADON 219
Measuring Methods
Cryogenic method for measuring nuclides and fission gases (Patent), 6:17323

RADON 220
Measuring Methods
Cryogenic method for measuring nuclides and fission gases (Patent), 6:17323

RADON 222
Measuring Methods
Cryogenic method for measuring nuclides and fission gases (Patent), 6:17323
Spatial Distribution
Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas, 6:17442 (SAND—80-2573)

RAILGUN ACCELERATORS
Performance
Rail gun program, 6:17208 (LA—8669-MS)
Uses
Rail gun program, 6:17208 (LA—8669-MS)

RAILROAD CARS
Unloading
1980 national conference and workshop on coal freezing, 6:16448 (EPRI-WS—80-119)

RAMAN EFFECT
Mathematical Models
[Fluorescent scattering by molecules embedded in small particles]. Comprehensive report, 1977-1980, 6:17600 (DOE/EV/04361—T2)

RANKINE CYCLE POWER SYSTEMS
Design
Cost-effective waste-heat Organic Rankine Cycle application and systems designs, 6:17013 (CONF-800483—(Vol.2))
Economics
Cost-effective waste-heat Organic Rankine Cycle application and systems designs, 6:17013 (CONF-800483—(Vol.2))
Field Tests
Power generation from waste heat using organic Rankine cycle systems, 6:17012 (CONF-800483—(Vol.2))
Heat Recovery
Organic Rankine Cycle System: its application to extract energy from low-temperature waste heat, 6:17011 (CONF-800483—(Vol.2))
Power generation from waste heat using organic Rankine cycle systems, 6:17012 (CONF-800483—(Vol.2))
Performance
Organic Rankine Cycle System: its application to extract energy from low-temperature waste heat, 6:17011 (CONF-800483—(Vol.2))

RARE EARTH COMPOUNDS
Exchange Interactions
Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128
Ferromagnetism
Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128
Transition Temperature
Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128

RATS
Behavior
Phenobarbital effects on weight gain and circadian cycling of food intake and body temperature, 6:17536

RAYLEIGH-TAYLOR INSTABILITY
Nonlinear Problems
Heuristic model of the nonlinear Rayleigh-Taylor instability, 6:17759
REACTION INTERMEDIATES
Electron Spin Resonance
Magnetophotoselection of the triplet state of reaction centers from Rhodopseudomonas sphaeroides R-26, 6:17483
REACTOR ACCIDENTS
See also LOSS OF COOLANT
LOSS OF FLOW
Reporter at large: Three Mile Island. I. Class nine accident, 6:16876
Data Acquisition Systems
Licensee event report sequence coding and search procedure: a training tool, 6:16863 (CONF-810411—)
Documentation
Reporter at large: Three Mile Island. II. The paper trail, 6:16875
Heat Transfer
Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)
Hydraulics
Development of computer code models for analysis of subassembly voiding in the LMFBR, 6:16866 (DOE/ET/37218—1)
Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)
Hydrogen Production
Controlling hydrogen behavior in light water reactors, 6:16873 (LA-UR—81-681)
Two-Phase Flow
Two dimensional, two fluid model for sodium boiling in LMFBR fuel assemblies, 6:16869 (DOE/ET/37218—4)
REACTOR COMPONENTS
See also FUEL ELEMENTS
Fabrication
Class 2 nuclear components (supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NCA and NC), 6:16850 (NE-E—15-2NC-T(1-81))
Standards
Class 2 nuclear components (supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NCA and NC), 6:16850 (NE-E—15-2NC-T(1-81))
REACTOR FUEL ELEMENTS
See FUEL ELEMENTS
REACTOR FUELING
Influence of core-assembly refueling requirements on LMFBR core-system design, 6:16839 (GEFR-SP—146)
REACTOR FUELS
See NUCLEAR FUELS
REACTOR INSTRUMENTATION
See also NOISE THERMOMETERS
Two-phase-flow velocity measurement using two full-flow drag bodies as transit-time flowmeters, 6:16864 (CONF-810434—1)
REACTOR INTERNALS
Hydraulics
Measurements of wall-pressure fluctuations on a cylinder in annular water flow with upstream disturbances. Part I. No flow spoilers (PWR; BWR), 6:16829 (GEAP—24310)
REACTOR MATERIALS
(See also specific materials.)
See also NUCLEAR FUELS
Creep
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
Standards
Cobalt-chromium alloy bars and shapes (Wear and corrosion resistance), 6:17114 (NE-M—7-7T(Rev.)(1-81))
Tensile Properties
Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report for period October 1, 1980-December 31, 1980, 6:16833 (DOE/ET/34202—15)
REACTOR OPERATION
Data Acquisition Systems
Licensee event report sequence coding and search procedure: a training tool, 6:16863 (CONF-810411—)
REACTOR OPERATORS
Education
Academic involvement in shift technical advisor training for the utilities, 6:16820 (CONF-810411—)
Best nuclear simulator, 6:16815 (CONF-810411—)
College and university programs for meeting the needs of educating nuclear power plant personnel, 6:16817 (CONF-810411—)
Education and training of the shift technical advisor, 6:16818 (CONF-810411—)
Human factors in training, 6:16822 (CONF-810411—)
Job and task analysis: a view from the inside, 6:16821 (CONF-810411—)
Organizing for change: new priorities for training organization in the nuclear industry, 6:16816 (CONF-810411—)
Revision to ANSI/ANS 3.1 1978: resulting from TMI-2, 6:16847 (CONF-810411—)
Shift technical advisors: in the eyes of the NRC, 6:16819 (CONF-810411—)
Towards accurate emergency response behavior, 6:16823 (CONF-810411—)
Training of nuclear facility personnel, 6:16814 (CONF-810411—)
Performance
Plant designer's view of the operator's role in nuclear plant safety, 6:16824 (CONF-810411—)
Towards accurate emergency response behavior, 6:16823 (CONF-810411—)
REACTOR SAFETY
(Theoretical and experimental investigations of the behavior of reactor types and designs under various real or hypothetical accidents.)
Reporter at large: Three Mile Island. I. Class nine accident, 6:16876
Research Programs
Light water reactor safety technology program. Quarterly report, October-December 1980, 6:16874 (SAND—81-0473)
REACTOR SIMULATORS
Specifications
Best nuclear simulator, 6:16815 (CONF-810411—)
REACTOR SITING
See SITE SELECTION
RECEIVERS (SOLAR)
See SOLAR RECEIVERS
RECEPTORS
Affinity
Effects of local anesthetics on cholinergic agonist binding affinity of central nervous system α-bungarotoxin receptors, 6:17478
Radionuclide Kinetics
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
Scintiscanning
Specific in vivo binding of ^{77}Br-p-bromospiroperidol in rat brain: a potential tool for gamma ray imaging, 6:17492
RECOIL CHEMISTRY
See HOT ATOM CHEMISTRY
RECOMBINANT DNA
Recommendations
How the NIH recombinant DNA Molecule Committee works in 1979, 6:17499
Research Programs
How the NIH recombinant DNA Molecule Committee works in 1979, 6:17499
RECYCLE (FUEL)
See FUEL CYCLE
REDOX FUEL CELLS
Electrochemistry
Workshop on electrodes for flowing solution batteries. Summary report, 6:16881 (EPRI-WS—79-192)
Electrodes
Workshop on electrodes for flowing solution batteries. Summary report, 6:16881 (EPRI-WS—79-192)

Evaluation
Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
Life-Cycle Cost
Analysis of batteries for use in photovoltaic systems. Final report, 6:16672 (DOE/ET/25202—1(Vol.1))
REDWING PRAIRIE ISLAND-1 REACTOR
See PRAIRIE ISLAND-1 REACTOR
REDWING PRAIRIE ISLAND-2 REACTOR
See PRAIRIE ISLAND-2 REACTOR
REFLECTIVE COATINGS
Reflectivity
Improved aluminum coatings for the ultraviolet, 6:17102 (LA-UR—81-747)
REFORMER PROCESSES
High-temperature gas-cooled reactor: reformer application study, 6:16834 (DOE/SF/02034—T10)
REFRACTORIES
Creep
Creep of monolithic refractory materials. Final report, 6:16370 (DOE/OR/13405—T1)
Electrochemical Corrosion
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Erosion
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
Materials Testing
MHD generator electrode development. Quarterly report, October-December 31, 1980, 6:16942 (DOE/ET/15529—9)
REFRACTORY METALS
Gas Tungsten-Arc Welding
Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)
REFRIGERATING MACHINERY
Pistons
Adjustable expandable cryogenic piston and ring (Patent), 6:17218
Rings
Adjustable expandable cryogenic piston and ring (Patent), 6:17218
REFUSE
See SOLID WASTES
REFUSE-FUELED POWER PLANTS
Energy from biomass and wastes: 1980 update, 6:16664
Environmental Impacts
Environmental assessment of a waste-to-energy process: Burlington Electric's wood and oil co-fired boiler, 6:16800 (PB—80-220627)
REGENERATION (BIOLOGICAL)
See BIOLOGICAL REGENERATION
REGENERATORS
Energy Efficiency
Fluid catalytic-cracking power-recovery dynamic computer simulation, 6:17010 (CONF-800483—(Vol.2))
REGION I
See NORTH ATLANTIC REGION
REGION II
See MID-ATLANTIC REGION
REGION III
See CENTRAL REGION
REGION IV
See SOUTHEAST REGION
REGION IX
See WESTERN REGION
REGION V
See GREAT LAKES REGION
REGION VI
See SOUTHWEST REGION
REGION VII
See MIDWEST REGION
REGION VIII
See ROCKY MOUNTAIN REGION
REGION X
See PACIFIC NORTHWEST REGION
REGIONAL ANALYSIS
Research Programs
Energy Analysis Program, FY 1980, 6:16888 (LBL—11972)
REGOLITH
See OVERBURDEN
REGULATIONS
See also POLLUTION REGULATIONS
Revision to ANSI/ANS 3.1 1978: resulting from TMI-2, 6:16847 (CONF-810411—)
Economic Impact
Coal industry problems. Final report, 6:16458 (EPRI-EA—1746)
Impact of regulation on industrial innovation, 6:16896
REMOTE HANDLING EQUIPMENT
Postirradiation examination of light water reactor fuel: a United States perspective, 6:16826 (CONF-800592—8)
Design
Microcomputer-controlled remote pipetter: design and evaluation of a prototype system, 6:17158 (ORNL/TM—7608)
Standards
Design guides for radioactive-material-handling facilities and equipment, 6:17206 (HEDL-SA—2191)
RENEWABLE ENERGY SOURCES
See also BIOMASS
GEOTHERMAL ENERGY
HYDROELECTRIC POWER
SOLAR ENERGY
WIND POWER
Commercialization
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Equipment
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
REPUBLIC OF KOREA
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)
Trade
INCHEM Tokyo 79, 6:16897
RESEARCH PROGRAMS
See also DEMONSTRATION PROGRAMS
Evaluation
Review of methods for evaluating R and D, 6:16906 (UCID—18890)
Program Management
Management and use of DOE-provided discretionary funds. Progress report, January-December 1980, 6:16901 (DOE/ER/10004—3)
RESERVOIR ROCK
Oil Saturation
Determination of residual oil saturation in drilling project Maustrenk DF 1 by routine core analyses and relative permeabilities, 6:16469 (CONF-8004140—)
Permeability
Determination of residual oil saturation in drilling project Maustrenk DF 1 by routine core analyses and relative permeabilities, 6:16469 (CONF-8004140—)
Scaled physical model studies of the steam drive process. Second annual report, September 1978-September 1979, 6:16486 (DOE/ET/12075—2)
Wettability
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)
Towards understanding wettability effects on oil recovery, 6:16473 (CONF-8004140—)
Wettability, the key to proper laboratory waterflooding experiments, 6:16467 (CONF-8004140—)
RESERVOIRS (WATER)
See WATER RESERVOIRS
RESIDENTIAL BUILDINGS
See also APARTMENT BUILDINGS
HOUSES

Electric Power
Energy savings attributable to switching from master metering to individual metering of electricity, 6:16956 (ANL/EES-TM—124)
Energy Analysis
Simplified heating and cooling energy analysis calculations for residential applications, 6:16974 (PB—80-213986)
Energy Conservation
Major models and data sources for residential and commercial sector energy conservation analysis. Final report, 6:16960 (DOE/PE/70044—T2)
Proposed residential building standards: draft environmental impact report, 6:16969 (P—700-80-013)
Environmental Impacts
Proposed residential building standards: draft environmental impact report, 6:16969 (P—700-80-013)
Photovoltaic Power Supplies
Heat pumps and utility-interactive photovoltaic power systems, 6:16668 (DOE/ET/20279—120)
Residential solar-photovoltaic power systems: the need for battery storage, 6:16667 (CONF-800567—5)
Solar Space Heating
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Solar Water Heating
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Ventilation
Test results and methods: residential air-to-air heat exchangers for maintaining indoor air quality and saving money, 6:16964 (LBL—12280)
RESIDENTIAL SECTOR
Fuels
Regional variations in US residential-sector fuel prices: implications for development of building energy-performance standards, 6:16976 (PNL—3605)
Geothermal District Heating
Boise geothermal district heating, 1892-1982. Part I. Institutional planning, 6:16759
RESIDUAL FUELS
Combustion Products
Practical considerations in controlling plume opacity on an oil-fired boiler, 6:16506
Fuel Additives
Practical considerations in controlling plume opacity on an oil-fired boiler, 6:16506
RESIDUAL PETROLEUM
Coking
Role of the FLEXICOKING process in heavy-oil processing, 6:16490 (CONF-800483—(Vol.2))
Measuring Methods
Determination of residual oil saturation in drilling project Maustrenk DF 1 by routine core analyses and relative permeabilities, 6:16469 (CONF-8004140—)
Mobility
Measurement and correlation of conditions for entrapment and mobilization of residual oil, 6:16470 (CONF-8004140—)
Towards understanding wettability effects on oil recovery, 6:16473 (CONF-8004140—)
RESIDUES (RADIOACTIVE)
See RADIOACTIVE WASTES
RESISTIVITY (ELECTRIC)
See ELECTRIC CONDUCTIVITY
RESISTIVITY SURVEYS
Computer Codes
Documentation and analysis of the Schlumberger interactive 1-D inversion program slumb, 6:16730 (DOE/ET/27002—2)
Interactive modeling system for 2-D magneto-telluric and line source resistivity data (MT2D users guide and documentation), 6:16729 (DOE/ET/27002—1)
Data Analysis
Documentation and analysis of the Schlumberger interactive 1-D inversion program slumb, 6:16730 (DOE/ET/27002—2)
Interactive modeling system for 2-D magneto-telluric and line source resistivity data (MT2D users guide and documentation), 6:16729 (DOE/ET/27002—1)
RESONANCE CAVITIES
See CAVITY RESONATORS
RESOURCE DEVELOPMENT
Economic Impact
Socioeconomic issues associated with the use of peat as an energy resource, 6:17449 (TR—80/031-001)
Environmental Impacts
Assessment of potential environmental impacts of geopressured methane development. Final report for 1979, 6:16514 (PB—80-210701)
Evaluation of environmental issues on the use of peat as an energy source, 6:16417 (TR—80/031-001)
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
International Cooperation
A report to: the President and the Congress, by the National Advisory Committee on Oceans and Atmosphere, annual report (6th) June 30, 1977, 6:16923 (PB—80-209190)
Social Impact
Socioeconomic issues associated with the use of peat as an energy resource, 6:17449 (TR—80/031-001)
Socio-Economic Factors
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
RESPIRATORY TRACT CELLS
Growth
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
RESTRAINTS
Damping
Guy cable design and damping for vertical axis wind turbines, 6:16782 (SAND—80-2669C)
Mechanical Vibrations
Guy cable design and damping for vertical axis wind turbines, 6:16782 (SAND—80-2669C)
Stresses
Guy cable design and damping for vertical axis wind turbines, 6:16782 (SAND—80-2669C)
RETROFITTING
Technology Utilization
Industrial-conservation-technology energy-savings monitoring system, 6:17030 (CONF-800483—(Vol.2))
REVERSE-FIELD PINCH
Field-reversed configurations: theoretical considerations and reactor applications, 6:17871 (PPPL—1755)
Computerized Simulation
Zero dimensional modeling of field-reverse theta pinch machines, 6:17792 (PPPL—1755)
Equilibrium
Field reversal experiments: FRX-A and FRX-B results, 6:17785 (PPPL—1755)
Equilibrium Plasma
Compact torus theory: MHD equilibrium and stability, 6:17787 (PPPL—1755)
Impurities
Effects of impurity radiation on reversed-field pinch evolution, 6:17817
Effects of impurity radiation on reversed-field pinch evolution, 6:17784 (PPPL—1755)
Kink Instability
Thermal background effects on the kink instability of a field-reversing ion layer, 6:17776 (PPPL—1755)
Mathematical Models
Plasma rotation in field-reversed theta pinches, 6:17793 (PPPL—1755)
Measuring Methods
Method of inferring the magnetic field profiles in the reversed-field pinch, 6:17766 (LA—8738-MS)
Plasma Confinement
FRX-C and multiple-cell experiments, 6:17786 (PPPL—1755)
Some properties of the heating and confinement in the RFP configuration, 6:17782 (PPPL—1755)

Plasma Heating
Some properties of the heating and confinement in the RFP configuration, 6:17782 (PPPL—1755)
Plasma Macroinstabilities
Compact torus theory: MHD equilibrium and stability, 6:17787 (PPPL—1755)
Periodic field-reversed equilibria for a multiple-cell linear theta pinch, 6:17791 (PPPL—1755)
Tilting mode in the reversed-field theta pinch, 6:17790 (PPPL—1755)
Reviews
Toroidal reversed field-pinch experiments, 6:17856 (PPPL—1755)
Size
Preliminary reactor implications of compact tori: how small is compact, 6:17878 (PPPL—1755)
Tearing Instability
Observations of plasma tearing instabilities and associated axial translation in field-reversed experiments, 6:17765 (LA—8729-MS)
Tearing-mode stability analysis of a cylindrical plasma, 6:17789 (PPPL—1755)
Two-Dimensional Calculations
Two-dimensional simulation of compact torus formation, 6:17788 (PPPL—1755)
Two-dimensional compression in general compact tori, 6:17857 (PPPL—1755)
Variational Methods
Relaxation of toroidal discharges, 6:17783 (PPPL—1755)

RHEUMATIC DISEASES
Radiotherapy
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

RHODANATES
See THIOCYANATES

RHODANIDES
See THIOCYANATES

RHODE ISLAND
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)

RHODIUM BORIDES
Exchange Interactions
Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128
Ferromagnetism
Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128
Transition Temperature
Ferromagnetism in the $RERh_4B_4$ compounds, 6:17128

RHODOPSEUDOMONAS
Photochemical Reactions
Magnetophotoselection of the triplet state of reaction centers from Rhodopseudomonas sphaeroides R-26, 6:17483
Photochemistry
Orientation of the primary donor in bacterial photosynthesis, 6:17498

RIBONUCLEIC ACID
See RNA

RICHLAND FFTF REACTOR
See FFTF REACTOR

RIEMANN WAVES
See SHOCK WAVES

RIFT ZONES
Seismic Surveys
Seismic exploration for shallow magma bodies in the vicinity of Socorro, New Mexico. Final report, January 1, 1977-December 31, 1977, 6:16741 (NP—25336)

RINGS (STORAGE)
See STORAGE RINGS

RIO GRANDE RIFT
Gravity Surveys
Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau, 6:16737 (LA—8676-T)
Magnetotelluric Surveys
Geophysical study of the crust and upper mantle beneath the central Rio Grande rift and adjacent Great Plains and Colorado Plateau, 6:16737 (LA—8676-T)

RISER CRACKING
See COAL LIQUEFACTION

RNA
(Ribonucleic acid.)
Biosynthesis
LA-UR—81-859 (CHO cells), 6:17529 (CONF-810350—1)

ROADWAY-POWERED ELECTRIC VEHICLES
Demonstration Programs
Roadway powered electric vehicle (RPEV) system concept description and project overview, 6:17073 (UCRL—85425)
Performance
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
Performance Testing
Roadway powered electric vehicle (RPEV) system concept description and project overview, 6:17073 (UCRL—85425)
Technology Assessment
Advanced vehicle of the DOE electric and hybrid vehicle program, 6:17072 (UCRL—85390)
Test Facilities
Roadway powered electric vehicle (RPEV) system concept description and project overview, 6:17073 (UCRL—85425)

ROCKS
See also ARGILLITE
CONGLOMERATES
RESERVOIR ROCK
Compression Strength
Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980, 6:16428 (DOE/TIC—11445)
Hardness
Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980, 6:16428 (DOE/TIC—11445)

ROCKWELL INTERNATIONAL PROCESS
See MOLTEN SALT COAL GASIFICATION PROCESS

ROCKY FLATS PLANT
Decontamination
Soil decontamination at Rocky Flats Plant, 6:17410 (CONF-791234—)

ROCKY MOUNTAIN REGION
See also COLORADO
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
UTAH
Interconnected Power Systems
Power pooling in the North Central Region, 6:16929 (FERC—0052)
Power pooling in the Western Region, 6:16931 (FERC—0054)

ROOF BOLTS
Installation
Inorganic cement for mine roof-bolt grouting, 6:16423 (BM-RI—8494)

ROOFS
Bibliographies
Roofing research: a bibliography, 6:16967 (ORNL/TM—7629)
Building Materials
Roofing research: a bibliography, 6:16967 (ORNL/TM—7629)
Construction
Roofing research: a bibliography, 6:16967 (ORNL/TM—7629)
Performance
Roofing research: a bibliography, 6:16967 (ORNL/TM—7629)
Stability
Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 2. Detailed report. Final report, 1974-76, 6:16433 (PB—80-219462)

ROOSEVELT HOT SPRINGS
Geologic Structures
Structural fabric and in-situ stress analyses of the Roosevelt Hot Springs KGRA, 6:16727 (DOE/ET/28392—31)
Induced Polarization Logging
Induced-polarization measurements at Roosevelt Hot Springs Thermal area, Utah, 6:16731 (DOE/ET/28392—23)

Resistivity Surveys
Induced-polarization measurements at Roosevelt Hot Springs Thermal area, Utah, 6:16731 (DOE/ET/28392—23)
ROTORS
See also DARRIEUS ROTORS
Mechanical Vibrations
Experimental study of the critical speed response, of a Jeffcot rotor with acceleration, 6:17219
RUBIDIUM
Ion-Atom Collisions
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
RUBIDIUM 90
Beta-Minus Decay
Decay of ^{90}Rb/sup g/ and ^{90}Rb/sup m/, 6:17715
RUBIDIUM CHLORIDES
Polarizability
Energy-related atomic and molecular structure and scattering studies. Annual progress report, July 1, 1980-June 30, 1981, 6:17594 (DOE/ER/04971—3)

S

SAFETY (NUCLEAR)
See RADIATION PROTECTION
SAFETY STANDARDS
Criteria development methodology for DOE decommissioning operations, 6:17418 (CONF-791234—)
SALES
See TRADE
SALMONELLA TYPHIMURIUM
Sensitivity
Mutagenicity of soot and associated polycyclic aromatic hydrocarbons to Salmonella typhimurium, 6:17537
SALT CAVERNS
Solution Mining
Strategic Petroleum Reserve annual report, 6:16505 (DOE/RA—0047/1)
SALT DEPOSITS
Creep
Creep of 50-mm diameter specimens of dome salt from Avery Island, Louisiana, 6:17552 (ONWI—104)
Stress Analysis
Creep of 50-mm diameter specimens of dome salt from Avery Island, Louisiana, 6:17552 (ONWI—104)
Temperature Effects
Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature, 6:17554 (UCRL—83789(Rev.1))
Thermal Conductivity
Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature, 6:17554 (UCRL—83789(Rev.1))
Thermal Diffusivity
Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature, 6:17554 (UCRL—83789(Rev.1))
Thermal Expansion
Thermal conductivity, diffusivity and expansion of Avery Island salt at pressure and temperature, 6:17554 (UCRL—83789(Rev.1))
SALTON SEA
Tourism
Potential impacts of geothermal development on outdoor recreational use of the Salton Sea, 6:16745 (UCRL—13897(Rev.1))
SALTON SEA GEOTHERMAL FIELD
Aesthetics
Potential impacts of geothermal development on outdoor recreational use of the Salton Sea, 6:16745 (UCRL—13897(Rev.1))
Environmental Impacts
Potential impacts of geothermal development on outdoor recreational use of the Salton Sea, 6:16745 (UCRL—13897(Rev.1))
Socio-Economic Factors
Potential impacts of geothermal development on outdoor recreational use of the Salton Sea, 6:16745 (UCRL—13897(Rev.1))
SAMARIUM 154 TARGET
Argon 40 Reactions
Nuclear research with heavy ions. Annual progress report. January 1, 1980-December 31, 1980, 6:17724 (DOE/ER/13246—20)
SANDSTONES
Hydraulic Fracturing
Hydraulic-fracture propagation in layered rock: experimental studies of fracture containment, 6:16519 (SAND—80-2219C)
Seismic Surveys
Application of areal seismics to mapping sandstone channels, 6:16511 (SAND—81-0387C)
Sorptive Properties
Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—)
SASOL-II PROCESS
Economic Analysis
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
Feasibility Studies
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
SATELLITE POWER SYSTEM
See ORBITAL SOLAR POWER PLANTS
SATELLITE SOLAR POWER STATIONS
See ORBITAL SOLAR POWER PLANTS
SAVANNAH RIVER
Water Resources
Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina, 6:16622 (FERC—0075)
SAVANNAH RIVER PLANT
Ecology
Thermal ecology: environmental teachings of a nuclear reactor site, 6:17444
Radiation Monitoring
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)
Wells
Well data file at the Savannah River Plant, 6:17543 (DP-MS—80-131)
SCANNING (RADIOISOTOPE)
See RADIOISOTOPE SCANNING
SCHOOL BUILDINGS
Water Source Heat Pumps
Combination central heat steam and heat pump installation. A comparison of a school with and without heat recovery, 6:16979
SCHOOL FACILITIES
See EDUCATIONAL FACILITIES
SCHOOL PLANT
See EDUCATIONAL FACILITIES
SCINTIGRAPHY
See SCINTISCANNING
SCINTILLATION COUNTERS
Bismuth Compounds
Imaging properties of a positron tomograph with 280 BGO crystals, 6:17491 (LBL—11858)
Comparative Evaluations
Imaging properties of a positron tomograph with 280 BGO crystals, 6:17491 (LBL—11858)
SCINTISCANNING
Comparative Evaluations
Positron tomographic imaging of the liver: ^{68}Ga iron hydroxide colloid, 6:17494
SCRUBBERS
Bibliographies
Scrubber-generated particulate: literature survey. Final report, 6:17352 (EPRI-CS—1739)

Comparative Evaluations
Economics of four FGD systems. Final report, 6:16794 (EPRI-CS—1677)
Corrosion
Construction materials for wet scrubbers. Final report, 6:16795 (EPRI-CS—1736(Vol.1))
Construction materials for wet scrubbers. Volume 2. Final report, 6:16406 (EPRI-CS—1736(Vol.2))
Emission
Scrubber-generated particulate: literature survey. Final report, 6:17352 (EPRI-CS—1739)
Materials
Construction materials for wet scrubbers. Final report, 6:16795 (EPRI-CS—1736(Vol.1))
Construction materials for wet scrubbers. Volume 2. Final report, 6:16406 (EPRI-CS—1736(Vol.2))

SEA BED
Oceanography
Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas, 6:17442 (SAND—80-2573)
Radionuclide Migration
Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas, 6:17442 (SAND—80-2573)
Tracer Techniques
Physical oceanographic characteristics influencing the dispersion of dissolved tracers released at the sea floor in selected deep ocean study areas, 6:17442 (SAND—80-2573)

SEA DISPOSAL
See MARINE DISPOSAL

SEALS
Fabrication
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)

SEAS
See also SALTON SEA
Heat Transfer
Comments on "Bulk parameterization of air-sea exchanges of heat and water vapor including the molecular constraints at the interface" , 6:17558
Roughness
Comments on "Bulk parameterization of air-sea exchanges of heat and water vapor including the molecular constraints at the interface" , 6:17558

SEAWATER
Corrosive Effects
Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
Solvent Properties
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)

SEBACEOUS GLANDS
See SKIN

SECURITY
Personnel
Nuclear security officer training, 6:16825 (CONF-810411—)

SEDIMENTS
Chemistry
Chemistry of bottom sediments from the Cal-Sag channel and the Des Plaines and Illinois Rivers between Joliet and Havana, Illinois, 6:17433 (ANL/ES—112)
Dissolved Gases
Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)
Gas Analysis
Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)
Physical Properties
Gases in the marine sedimentary environment: causes and effects, 6:17445 (SAND—81-0210)

SEEDS
Energy Source Development
Chinese tallow tree as a cash and petroleum-substitute crop, 6:16659 (SERI/CP—622-1086)
Fermentation
Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)
Oils
Chinese tallow tree as a cash and petroleum-substitute crop, 6:16659 (SERI/CP—622-1086)
Uses
Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)

SELENIUM
Ecological Concentration
Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583

SELENIUM 75
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Scintiscanning
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

SELENIUM FLUORIDES
Infrared Spectra
High resolution infrared studies of dynamics in low temperature matrics: Vibrational dephasing for SeF_6 in noble gas solids, 6:17610

SELENIUM ISOTOPES
Radioisotope Scanning
Adrenal imaging agents, 6:17196 (DOE/EV/04115—4)

SEMICONDUCTOR MATERIALS
(See also specific semiconductor materials.)
Annealing
Influence of carrier diffusion on melt-front penetration during pulsed-laser annealing, 6:17147
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
Carrier Mobility
Influence of carrier diffusion on melt-front penetration during pulsed-laser annealing, 6:17147
Charge Carriers
Influence of carrier diffusion on melt-front penetration during pulsed-laser annealing, 6:17147
Corrosion
Corrosion Research Center of the University of Minnesota. Progress report, July 1, 1980-December 31, 1980, 6:17096 (DOE/ER/10450—1)

SEMIMETALS
See also ARSENIC
BORON
GERMANIUM
SELENIUM
SILICON
TELLURIUM
Electronic Structure
Study of local atomic and electronic structure in glassy metallic alloys. Progress report, December 1, 1979-November 1, 1980, 6:17121 (DOE/ER/10382—2)

SEPTUM MAGNETS
Specifications
Improved copper septum magnet design, 6:17261 (BNL—29083)

SERUM (BLOOD)
See BLOOD SERUM

SERUM (IMMUNE)
See IMMUNE SERUMS

SEWAGE
See LIQUID WASTES

SEWAGE SLUDGE
Anaerobic Digestion
Full scale field demonstration of unheated anaerobic contact stabilization. Quarterly project status report, July 1980-September 1980, 6:16603 (DOE/CS/24310—2)
Radiosterilization
Design criteria for dry-sludge irradiation demonstration plant (DSIDP), 6:16590 (SAND—81-7069)

SEWAGE TREATMENT
See WASTE PROCESSING

SHALE OIL
Environmental Effects
Environmental control technology for shale oil wastewaters, 6:17456 (PNL—3700(Pt.5))
SHALES
See also OIL SHALES
Fractures
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
Permeability
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
Porosity
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
SHEARER LOADERS
Dusts
Reducing dust at longwall shearers by confining the dust cloud to the face, 6:16424 (BM-TPR—111)
SHELL-KOPPERS GASIFICATION PROCESS
Comparative Evaluations
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
SHIELDING
Information Needs
FMIT related problems: shielding and materials damage studies, 6:17683 (DOE/NDC—21/L(Vol.1))
SHIFT PROCESSES
Catalysts
Combined shift and methanation in a fluidized-bed reactor. Final report, 25 September 1979-31 December 1980, 6:16354 (DOE/ET/14815—20)
Investigation of carbon deposition on fluidized methanation catalysts. Appendix, 6:16355 (DOE/ET/14815—20)
SHOCK ABSORBERS
Design
Device for absorbing mechanical shock (Patent), 6:17207
SHOCK (IMPACT)
See IMPACT SHOCK
SHOCK WAVES
Laser Radiation
Physical optics of the laser-schlieren shock tube technique, 6:17626
Optics
Physical optics of the laser-schlieren shock tube technique, 6:17626
Velocimeters
Particle—velocity gauge system for nanosecond sampling rate of shock and detonation waves, 6:17332
SHOPPING CENTERS
Geothermal District Heating
Boise geothermal district heating, 1892-1982. Part I. Institutional planning, 6:16759
SHOWER COUNTERS
(Detects high energy gamma radiation or high energy particles on basis of cascade showers in layered absorbers.)
Energy Resolution
Sampling calorimeters in high energy physics, 6:17318 (SLAC—239)
Reviews
Sampling calorimeters in high energy physics, 6:17318 (SLAC—239)
Spatial Resolution
Sampling calorimeters in high energy physics, 6:17318 (SLAC—239)
SILANES
Deposition
Optical emission studies of reactive species in plasma deposition, 6:17137 (BNL—29161)
Optical Properties
Optical emission studies of reactive species in plasma deposition, 6:17137 (BNL—29161)
SILICATES
Chemical Preparation
Wet chemical method for the production of synthetic raw materials and homogeneous powders for physical-chemical studies, 6:17167 (IS-Trans—111)
SILICON
Annealing
Control of melt-front velocity during pulsed laser annealing, 6:17146
Macroscopic theory of pulsed-laser annealing. I. Thermal transport and melting, 6:17145
Transmission electron microscopy and Rutherford backscattering studies of single and double discrete buried damage layers in P^+ implanted Si on subsequent laser annealing, 6:17150
Crystal Defects
EBIC and HVTEM studies of RTR silicon ribbon, 6:16647 (DOE/JPL/954852—7)
Crystal Growth
Silicon ingot casting - heat exchanger method (HEM); multi-wire slicing - fixed abrasive slicing technique (FAST). Phase IV. Silicon sheet growth development for the Large Area Sheet Task of the Low-Cost Solar Array Project. Quarterly progress report No. 4, October 1-December 31, 1980, 6:16646 (DOE/JPL/954373—80/18)
Cutting
Silicon ingot casting - heat exchanger method (HEM); multi-wire slicing - fixed abrasive slicing technique (FAST). Phase IV. Silicon sheet growth development for the Large Area Sheet Task of the Low-Cost Solar Array Project. Quarterly progress report No. 4, October 1-December 31, 1980, 6:16646 (DOE/JPL/954373—80/18)
Damage
Transmission electron microscopy and Rutherford backscattering studies of single and double discrete buried damage layers in P^+ implanted Si on subsequent laser annealing, 6:17150
Dislocations
Transmission electron microscopy and Rutherford backscattering studies of single and double discrete buried damage layers in P^+ implanted Si on subsequent laser annealing, 6:17150
Electric Conductivity
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Electrical Properties
Influence of grain boundaries on the electrical properties of polycrystalline-silicon films. Progress report, 1980-1981, 6:17140 (DOE/ER/02899—T2)
Electronic Structure
Determination of PSEUDOGAP state density and carrier mobility in r.f. sputtered amorphous silicon. Quarterly technical progress report, July 1, 1979-September 30, 1979, 6:16643 (DOE/ET/23037—1)
Study of gap states in a-Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells, 6:16637 (BNL—29160)
Grain Boundaries
Influence of grain boundaries on the electrical properties of polycrystalline-silicon films. Progress report, 1980-1981, 6:17140 (DOE/ER/02899—T2)
Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980, 6:16644 (DOE/ET/23106—4)
Studies of the hydrogen passivation of silicon grain boundaries, 6:17153
Impurities
Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980, 6:16662 (SERI/TR—8272-1-T1)
Melting
Macroscopic theory of pulsed-laser annealing. I. Thermal transport and melting, 6:17145

Microstructure
Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980, 6:16662 (SERI/TR—8272-1-T1)
Optical Properties
Production and evaluation of a-GaAs solar cells. Final technical report, August 1, 1979-July 31, 1980, 6:16642 (DOE/ET/23036—4)
Passivation
Studies of the hydrogen passivation of silicon grain boundaries, 6:17153
Sputtering
Determination of PSEUDOGAP state density and carrier mobility in r.f. sputtered amorphous silicon. Quarterly technical progress report, July 1, 1979-September 30, 1979, 6:16643 (DOE/ET/23037—1)
Transmission Electron Microscopy
Transmission electron microscopy and Rutherford backscattering studies of single and double discrete buried damage layers in P^+ implanted Si on subsequent laser annealing, 6:17150

SILICON 28
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322

SILICON 28 TARGET
Neutron Reactions
Scattering of 10 MeV neutrons by silicon, 6:17700 (DOE/NDC—21/L(Vol.1))

SILICON 31
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322

SILICON COMPOUNDS
Chemical Reactions
Application of selected chemical reactions to the organic chemistry of coal (Ms thesis; 146 references), 6:16397 (IS-T—948)

SILICON HYDRIDES
See SILANES

SILICON NITRIDES
Phase Studies
Liquid-phase-sintering phenomena of non-oxide silicon compounds. Technical progress report, 1 July 1979-29 February 1980, 6:17139 (DOE/ER/01885—T1)
Sintering
Liquid-phase-sintering phenomena of non-oxide silicon compounds. Technical progress report, 1 July 1979-29 February 1980, 6:17139 (DOE/ER/01885—T1)

SILICON OXIDES
See also QUARTZ
Damage
Determination of laser damage thresholds by comparison with an absolute laser damage standard, 6:17141
Laser Radiation
Determination of laser damage thresholds by comparison with an absolute laser damage standard, 6:17141
Optical Properties
High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers, 6:17890
Order-Disorder Transformations
Glassy thin films. Final report, 6:17118 (DOE/DP/40095—T1)

SILICON SOLAR CELLS
Charge Transport
Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980, 6:16644 (DOE/ET/23106—4)
Crystal Defects
EBIC and HVTEM studies of RTR silicon ribbon, 6:16647 (DOE/JPL/954852—7)
Design
Silicon concentrator solar cell development, 6:16657 (SAND—81-7005)
Fabrication
Concentrator-solar-cell development. Final technical report, 27 March 1979-30 March 1980, 6:16656 (SAND—81-7002)
Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980, 6:16662 (SERI/TR—8272-1-T1)
Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980, 6:16644 (DOE/ET/23106—4)
Grain Boundaries
Photovoltaic mechanisms in polycrystalline thin-film silicon solar cells. Final report, July 31, 1979-September 30, 1980, 6:16644 (DOE/ET/23106—4)
Impurities
Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980, 6:16662 (SERI/TR—8272-1-T1)
Silicon materials task of the Low-Cost Solar Array Project: Phase IV. Effects of impurities and processing on silicon solar cells. Twenty-first quarterly report, October-December 1980, 6:16645 (DOE/JPL/954331—81/13)
Microstructure
Investigation of the impurity tolerance of semicrystalline silicon solar cells silicon impact program. Final report, September 15, 1979-September 14, 1980, 6:16662 (SERI/TR—8272-1-T1)
Performance
Silicon concentrator solar cell development, 6:16657 (SAND—81-7005)
Photoconductivity
Study of gap states in a-Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells, 6:16637 (BNL—29160)
Spectral Response
Study of gap states in a-Si:H alloys by measurements of photoconductivity and spectral response of MIS solar cells, 6:16637 (BNL—29160)

SILICONES
Physical Properties
Evaluation of silicone foam for flat plate solar collector insulation, 6:16722

SILICOSIS
See PNEUMOCONIOSES

SILOXANES
See also SILICONES
Chemical Preparation
Effect of vinyl and phenyl contents of silicone gum on the properties of the elastomers and cellular silicone cushions, 6:17132 (UCRL—53105)
Mechanical Properties
Effect of vinyl and phenyl contents of silicone gum on the properties of the elastomers and cellular silicone cushions, 6:17132 (UCRL—53105)

SILT
Fractures
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
Permeability
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)
Porosity
Computer model for determining fracture porosity and permeability in the Conasauga Group, Oak Ridge National Laboratory, Tennessee, 6:17553 (ORNL/TM—7695)

SILVER
Argon 40 Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
Carbon 12 Reactions
Study of neutron deficient isotopes of Fr and I by means of He-jet technique, 6:17727

SILVER 110
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)

SILVER COMPLEXES
Orthorhombic Lattices
Crystal-structure determinations of Lu_9S_4, nonstoichiometric $Nb_{1.06}S_2$, and three Group VIII coordination complexes, 6:17166 (IS-T—911)
SILVER IODIDES
Absorption Spectra
Absorption spectra of AgI at pressures to 136 kbar, 6:17142 (LA-UR—81-1021)
Crystal-Phase Transformations
Absorption spectra of AgI at pressures to 136 kbar, 6:17142 (LA-UR—81-1021)
SITE SELECTION
Planning
Site Development Planning Handbook, 6:17424 (DOE/AD/06212—1)
SKIN
Radiation Doses
Beta and low energy photon response, 6:17310 (PNL—3536)
SLAGGING PYROLYSIS PROCESS
Feasibility Studies
Waste incineration, 6:16559 (CONF-791234—)
SLAGS
Electrical Properties
Chemistry and physics of coal utilization - 1980, 6:16400
Evaporation
Condensation processes in coal-combustion products. Progress report, July 1, 1980-June 30, 1981, 6:16453 (DOE/ER/10456—2)
SLUDGES
See SLURRIES
SLUGS (FUEL)
See FUEL RODS
SLURRIES
Titration
Liquefaction of Douglas Fir wood slurries: titration of acids and anions in aqueous product and feed slurries, 6:16606 (LBL—12331)
SLURRIES (FUEL)
See FUEL SLURRIES
SLURRY PIPELINES
Feasibility Studies
Pacific bulk commodity transportation system, executive summary. Final report, 6:16449 (PB—80-222565)
Pacific bulk commodity transportation system, Volume II. final report, 6:16450 (PB—80-222573)
SMOG
Mathematical Models
Transportation systems and regional air quality - photochemiCal modeling of Sacramento, California region. Interim report, April 1976-October 1979, 6:17359 (PB—80-210800)
SODIUM
Atom Collisions
Low work function surface for improving the yield of negative hydrogen ions, 6:17578 (BNL—51304)
Boiling
Development of a model to predict flow oscillations in low-flow sodium boiling (Loss-of-Piping Integrity accidents), 6:16867 (DOE/ET/37218—2)
Ion-Atom Collisions
Prospects for negative ion systems based on charge exchange, 6:17585 (BNL—51304)
Stripping of 30-2000 keV H^- ions, 6:17589 (BNL—51304)
Theoretical investigations of the collision dynamics in H^- formation and destruction, 6:17571 (BNL—51304)
Ionization
Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304)
SODIUM 24
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
SODIUM CHLORIDES
Density
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
Specific Heat
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
SODIUM COMPOUNDS
Density
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Hot Pressing
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Leaching
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
Porosity
Effect of hot-pressing conditions on the properties of iodide sodalite, 6:16570 (RHO-LD—153)
SODIUM NITRATES
Corrosive Effects
Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Physical Properties
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
SODIUM NITRIDES
Corrosive Effects
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Physical Properties
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
SODIUM SILICATES
Electrical Properties
Properties of glasses with high water content. Progress report, 1 March 1980-31 January 1981, 6:17123 (DOE/ER/10453—2)
SODIUM SULFATES
Specific Heat
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)
SOILS
Contamination
Surface soil contamination standards for Rockwell Hanford Operations, 6:17412 (CONF-791234—)
Decontamination
LASL experience in decontamination of the environment, 6:17404 (CONF-791234—)
Methods and costs for soil removal, 6:17414 (CONF-791234—)
Nevada Operations overview, 6:17405 (CONF-791234—)
Site decontamination, 6:17408 (CONF-791234—)
Soil decontamination at Rocky Flats Plant, 6:17410 (CONF-791234—)
Soil surface decontamination and revegetation progress, 6:17413 (CONF-791234—)
Revegetation
Soil surface decontamination and revegetation progress, 6:17413 (CONF-791234—)
SOLAR ABSORBERS
Bonding
Bonding solar selective absorber foils to glass receiver tubes for use in evacuated tubular collectors: preliminary studies, 6:16712 (LA-UR—81-1023)
SOLAR AIR CONDITIONERS
Chemical Heat Pumps
Use of an open-cycle absorption system for heating and cooling, 6:16703 (SERI/TP—631-1159)
Design
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Economic Analysis
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Rankine Cycle Engines
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)

SOLAR BATTERY CHARGERS
Economic Analysis
Solar energy for charging fork truck batteries, 6:16666 (CONF-800483—(Vol.2))
SOLAR CELL ARRAYS
See also PHOTOVOLTAIC POWER SUPPLIES
Construction
Interim standard for safety: flat-plate photovoltaic modules and panels. Volume 1. Construction requirements, 6:16674 (DOE/JPL/955298—T1)
Data Compilation
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))
Field Tests
Reliability of terrestrial photovoltaic modules at various DOE/MIT Lincoln Laboratory Test Sites, 6:16670 (DOE/ET/20279—126)
Manufacturers
Data base on batteries, power-conditioning equipment, and photovoltaic arrays. Final report, 6:16673 (DOE/ET/25202—1(Vol.2))
Safety
Interim standard for safety: flat-plate photovoltaic modules and panels. Volume 1. Construction requirements, 6:16674 (DOE/JPL/955298—T1)
SOLAR CELL RECEIVERS
See SOLAR RECEIVERS
SOLAR CELLS
See also CADMIUM SULFIDE SOLAR CELLS
CONCENTRATOR SOLAR CELLS
GALLIUM ARSENIDE SOLAR CELLS
INDIUM PHOSPHIDE SOLAR CELLS
SILICON SOLAR CELLS
Construction
Interim standard for safety: flat-plate photovoltaic modules and panels. Volume 1. Construction requirements, 6:16674 (DOE/JPL/955298—T1)
Manufacturing
Energy data report. Solar collector manufacturing activity, July through December 1980, 6:16710 (DOE/EIA—0174(80/2))
Safety
Interim standard for safety: flat-plate photovoltaic modules and panels. Volume 1. Construction requirements, 6:16674 (DOE/JPL/955298—T1)
Uses
Energy data report. Solar collector manufacturing activity, July through December 1980, 6:16710 (DOE/EIA—0174(80/2))
SOLAR COLLECTORS
See also EVACUATED TUBE COLLECTORS
FLAT PLATE COLLECTORS
PARABOLIC TROUGH COLLECTORS
SOLAR PONDS
TOWER FOCUS COLLECTORS
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Foundations
Full-scale load tests of experimental solar-collector foundations, 6:16718 (SAND—80-7076)
Manufacturing
Energy data report. Solar collector manufacturing activity, July through December 1980, 6:16710 (DOE/EIA—0174(80/2))
Uses
Energy data report. Solar collector manufacturing activity, July through December 1980, 6:16710 (DOE/EIA—0174(80/2))
SOLAR CONCENTRATORS
See also MIRRORS
SOLAR REFLECTORS
Bibliographies
Solar energy concentrator design and operation. 1970-July 1980 (citations from the Engineering Index data base). Report for 1970-July 1980 (220 citations), 6:16713 (PB—80-813934)
SOLAR COOLING SYSTEMS
See also SOLAR AIR CONDITIONERS
Design
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Installation
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Maintenance
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Operation
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
SOLAR ENERGY
Data Acquisition Systems
Results of an accuracy test of the Mod-II Site Data Acquisition System, 6:16688 (ANL/EES-TM—128)
Government Policies
Department of Energy responses to panel recommendations from the open workshop on solar technologies, 6:16632 (CONF-7910187—(Suppl.))
Information Needs
General solar energy information user study, 6:16628 (SERI/TR—751-753)
Solar energy storage researchers information user study, 6:16726 (SERI/TR—751-793)
Meetings
Department of Energy responses to panel recommendations from the open workshop on solar technologies, 6:16632 (CONF-7910187—(Suppl.))
Research Programs
Solar energy program, 6:16627 (LBL—11650)
Technology Assessment
Technology assessment, 6:17453 (PNL—3700(Pt.5))
Technology Transfer
Department of Energy responses to panel recommendations from the open workshop on solar technologies, 6:16632 (CONF-7910187—(Suppl.))
SOLAR ENERGY CONVERSION
Hydrogen Production
Photosynthetic water splitting, 6:16593 (CONF-810345—1)
Research Programs
Applied research in the solar thermal-energy-systems program, 6:16681 (SERI/TP—633-1148)
SOLAR HEAT ENGINES
Design
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
Economic Analysis
Design, development and testing of a solar-powered multi-family residential size prototype turbocompressor heat pump, 6:16696 (DOE/CS/34510—T1)
SOLAR HEATING SYSTEMS
See also PASSIVE SOLAR HEATING SYSTEMS
Chemical Heat Pumps
Use of an open-cycle absorption system for heating and cooling, 6:16703 (SERI/TP—631-1159)
Computer Codes
Comparison of DOE-2 and TRNSYS solar-heating-system simulation, 6:16705 (SERI/TR—721-822)
Computerized Simulation
Comparison of DOE-2 and TRNSYS solar-heating-system simulation, 6:16705 (SERI/TR—721-822)
Design
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico, 6:16708 (SOLAR/1008—80/50)

Economic Analysis
Economic analysis of residential and commercial solar heating and hot water systems, 6:16691 (ANL-K—80-59)
Economic analysis of non-taxed commercial solar hot water systems and combined heating and hot water systems, 6:16689 (ANL-K—80-44)
Economic analysis of commercial solar combined space-heating and hot-water systems, 6:16690 (ANL-K—80-53)
Installation
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Maintenance
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Operation
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Performance
Economic analysis of non-taxed commercial solar hot water systems and combined heating and hot water systems, 6:16689 (ANL-K—80-44)

SOLAR INDUSTRY
Commercialization
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Equipment
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Surveys
Industrial and agricultural process heat information user study, 6:16707 (SERI/TR—751-751)

SOLAR KILNS
Demonstration Programs
Solar kiln demonstraction project. Semi-annual progress report (Lumber dryer), 6:16699 (DOE/R5/10246—1)
Design
Solar kiln demonstraction project. Semi-annual progress report (Lumber dryer), 6:16699 (DOE/R5/10246—1)

SOLAR PONDS
Applications of shallow solar ponds in wastewater treatment, 6:16720 (UCRL—15329)

SOLAR PROCESS HEAT
Flash pyrolysis of coal through solar heating, 6:16378 (LA-UR—81-764)
Attitudes
Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications, 6:16633 (SERI/TP—731-1128)
Demonstration Programs
High-temperature process-steam application at the Southern Union Refining Company, Hobbs, New Mexico (solar energy in the oil patch). Phase I design. Final report, 6:16695 (DOE/CS/32223—T1)
Solar production of industrial process steam. Phase III. Operation and evaluation of the Johnson and Johnson solar facility. Final report, January 1, 1980-March 31, 1981, 6:16694 (DOE/CS/31713—T1)
Economics
Solar thermal cost goals, 6:16630 (SERI/TR—633-1063)
Heat Storage
Value of thermal storage in solar IPH systems, 6:16706 (SERI/TR—731-905)
Information Needs
Industrial and agricultural process heat information user study, 6:16707 (SERI/TR—751-751)
Market
Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications, 6:16633 (SERI/TP—731-1128)
Research Programs
Status of current IPH applications, 6:16704 (SERI/TP—632-1123)
Retrofitting
Solar repowering/industrial retrofit systems study: Gulf Mt. Taylor Uranium Mill solar retrofit. Final technical report (Mt. Taylor Uranium Mill), 6:16701 (MDC-G—8656ES)

SOLAR RECEIVERS
Performance Testing
Operating experience at the Central Receiver Test Facility (CRTF), 6:16717 (SAND—80-2504C)

SOLAR REFLECTORS
Fabrication
Method of making reflecting film reflector (Patent), 6:16723

SOLAR REPOWERING
Feasibility Studies
Look to the future: solar repowering for tomorrow's energy needs, 6:16676 (CONF-800483—(Vol.2))

SOLAR SPACE HEATING
Economic Analysis
Economic analysis of residential combined solar-heating and hot-water systems, 6:16629 (ANL-K—80-63)

SOLAR THERMAL POWER PLANTS
See also DISTRIBUTED COLLECTOR POWER PLANTS
TOWER FOCUS POWER PLANTS
Attitudes
Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications, 6:16633 (SERI/TP—731-1128)
Economics
Solar thermal cost goals, 6:16630 (SERI/TR—633-1063)
Environmental Impacts
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)
Vegetation management and recovery at sites distrubed for solar thermal power systems development. Progress report for FY 1980, 6:16634 (UCLA—12-1281)
Heat Transfer Fluids
Molten nitrate salt technology development status report, 6:16680 (SAND—80-8052)
Hybrid Systems
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)
Market
Preferences and concerns of potential users in the selection of solar thermal systems for industrial and small utility applications, 6:16633 (SERI/TP—731-1128)
Research Programs
Applied research in the solar thermal-energy-systems program, 6:16681 (SERI/TP—633-1148)
Site Selection
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. I. Environmental assessment, 6:16635 (UCLA—12/1282)
Environmental effects of solar-thermal power systems. Environmental considerations in siting a solar-coal hybrid power plant. II. Air-quality and meteorological impacts, 6:16636 (UCLA—12/1283)

SOLAR THERMAL RECEIVERS
See SOLAR RECEIVERS

SOLAR WATER HEATERS
Design
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Solar project description for Homes by Marilynn multi-family residence, Albuquerque, New Mexico, 6:16708 (SOLAR/1008—80/50)

Economic Analysis
Economic analysis of residential and commercial solar heating and hot water systems, 6:16691 (ANL-K—80-59)
Economic analysis of non-taxed commercial solar hot water systems and combined heating and hot water systems, 6:16689 (ANL-K—80-44)
Economic analysis of residential solar water heaters, 6:16692 (ANL-K—80-68)
Economic analysis of commercial solar combined space-heating and hot-water systems, 6:16690 (ANL-K—80-53)
Installation
Reduction of energy usage in the Laundromat. Final report, 6:17036 (DOE/R5/10151—1)
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Leases
Solar lease grant program. Technical progress report, 6:16697 (DOE/R5/10213—1)
Maintenance
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Meetings
Hardware package and workshop development for homeowner solar water heater, 6:16700 (DOE/SF/01973—T1)
Operation
Solar heating and cooling of residential buildings: sizing, installation and operation of systems. 1980 edition, 6:16693 (DOE/CS/30062—1)
Performance
Economic analysis of non-taxed commercial solar hot water systems and combined heating and hot water systems, 6:16689 (ANL-K—80-44)

SOLAR WATER HEATING
Economic Analysis
Economic analysis of residential combined solar-heating and hot-water systems, 6:16629 (ANL-K—80-63)
Meetings
Hardware package and workshop development for homeowner solar water heater, 6:16700 (DOE/SF/01973—T1)

SOLAR WATER PUMPS
Distributed Collector Power Plants
1980 annual report of the Coolidge Solar Irrigation Project, 6:16679 (SAND—80-2378)
Performance
1980 annual report of the Coolidge Solar Irrigation Project, 6:16679 (SAND—80-2378)

SOLDERED JOINTS
Stress Analysis
Finite-element-method study of stresses on simulated electronic components encapsulated in polystyrene-bead foam, 6:17236 (BDX—613-2551)

SOLENOIDS
Magnetic Flux
Fringing fields and criticisms of the Aharonov-Bohm effect, 6:17757

SOLID WASTES
See also WOOD WASTES
Chemical Properties
Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979, 6:16410 (PB—80-222409)
Environmental Impacts
Environmental assessment data systems user guide: Solid Discharge Data System. Final report, September 1978-September 1979, 6:17904 (PB—80-212483)
Information Systems
Environmental assessment data systems user guide: Solid Discharge Data System. Final report, September 1978-September 1979, 6:17904 (PB—80-212483)
Physical Properties
Waste and water management for conventional coal combustion assessment report-1979. Volume III. Generation and characterization of FGC (flue gas cleaning) wastes. Final report, September 1977-August 1979, 6:16410 (PB—80-222409)
Waste Disposal
Experimental/engineering support for EPA's FBC program: final report. Volume III. Solid residue study. Final report, January 1977-December 1978, 6:16799 (PB—80-219256)

SOLIDS
Energy-Level Density
Density of states and the velocity autocorrelation function derived from quench studies, 6:17752
Sound Waves
Propagation of sound in a spin-glass, 6:17753
Vibrational States
Density of states and the velocity autocorrelation function derived from quench studies, 6:17752

SOLVENT-REFINING COAL PLANTS
See SRC PROCESS

SOMATOTROPIC HORMONE
See STH

SOOT
Diffusion flame studies of the chemical and physical mechanisms of soot formation from aromatic and substituted aromatic fuels. Progress report, July 15, 1980-February 15, 1981, 6:17201 (DOE/ER/10677—1)
Toxicity
Mutagenicity of soot and associated polycyclic aromatic hydrocarbons to Salmonella typhimurium, 6:17537

SORGHUM
Fermentation
Energy balances in the production and end use of alcohols derived from biomass. A fuels-specific comparative analysis of alternate ethanol production cycles, 6:16648 (DOE/PE/70151—T5)

SOUTH ATLANTIC BIGHT
Oceanography
Continental shelf processes affecting the oceanography of the South Atlantic Bight. Progress report, 1 June 1980-1 June 1981, 6:17555 (DOE/EV/00889—7(Vol.1))
First preliminary report of the GABEX-1 cruises: station logs, standard sections and maps and time series transects, 6:17556 (DOE/EV/00889—7(Vol.2))
Hydrographic observations off Savannah and Brunswick, Georgia: March, May and September 1977 and January 1978. Technical report 80-1, 6:17557 (DOE/EV/00889—7(Vol.3))

SOUTH CAROLINA
Peat
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
Water Resources
Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina, 6:16622 (FERC—0075)
Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report, 6:16620 (FERC—0073)

SOUTH DAKOTA
Magnetic Surveys
Aerial radiometric and magnetic survey: McIntosh National Topographic Map, North Dakota/South Dakota. Final report, 6:16543 (GJBX—86(81))
Radiometric Surveys
Aerial radiometric and magnetic survey: McIntosh National Topographic Map, North Dakota/South Dakota. Final report, 6:16543 (GJBX—86(81))
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)

SOUTH KOREA
See REPUBLIC OF KOREA

SOUTHEAST REGION
See also ALABAMA
GEORGIA
KENTUCKY

MISSISSIPPI
NORTH CAROLINA
SOUTH CAROLINA
TENNESSEE

Interconnected Power Systems
Power pooling in the South Central Region, 6:16930 (FERC—0053)

SOUTHWEST REGION
See also NEW MEXICO
OKLAHOMA
TEXAS

Interconnected Power Systems
Power pooling in the South Central Region, 6:16930 (FERC—0053)
Power pooling in the Western Region, 6:16931 (FERC—0054)

SOYBEAN PLANT
See GLYCINE HISPIDA

SPACE HEATING
Hot Water
Large field-erected and packaged high-temperature-water (HTW) generators for coal firing, 6:16999 (CONF-800483—(Vol.2))

SPACE HVAC SYSTEMS
Computerized Control Systems
Computerized control of environmental systems, 6:16957 (CONF-800483—(Vol.2))
Standards
Guide to the energy conservation regulations for new nonresidential buildings, 6:16968 (P—400-80-069)

SPACE LATTICES
See CRYSTAL LATTICES

SPACE PROPULSION REACTORS
Feasibility Studies
Reactors for nuclear electric propulsion, 6:16859 (LA-UR—81-703)
Specifications
Reactors for nuclear electric propulsion, 6:16859 (LA-UR—81-703)

SPACE REFLECTION
See P INVARIANCE

SPARK MASS SPECTROMETERS
Electron Multiplier Detectors
Electro-optical detector for spark source mass spectrometry. Pt. 2. Quantitative measurements, 6:17160

SPEAR
(2.5-GeV electron--positron storage ring at SLAC, Stanford University.)
NaI Detectors
Brief review of recent results from the crystal ball detector at SPEAR, 6:17633 (SLAC—239)

SPECIES DIVERSITY
Correlations
Functional complexity and ecosystem stability, 6:17398

SPECTRA
See also BETA SPECTRA
X-RAY SPECTRA
Measuring Instruments
High-precision multipass reflectometer, 6:17328 (LA-UR—81-679)

SPECTRALLY SELECTIVE SURFACES
See also BLACK COATINGS
Absorptivity
Design of selective surfaces for solar energy collection, 6:16711 (DOE/ET/20413—T1)
Electrodeposition
Black chromium-molybdenum: a new stable solar absorber, 6:16721
Emissivity
Design of selective surfaces for solar energy collection, 6:16711 (DOE/ET/20413—T1)
Spectral Reflectance
Black chromium-molybdenum: a new stable solar absorber, 6:16721

SPECTROMETERS
See also ELECTRON SPECTROMETERS
MASS SPECTROMETERS
NMR SPECTROMETERS
X-RAY SPECTROMETERS
Microwave Equipment
Microwave spectrometer for the detection of transient gaseous species, 6:17331

SPECTROSCOPY
Transients
Deep-level transient spectroscopy system using a spectrum analyzer, 6:17335

SPENT FUEL CASKS
Accidents
Transportation accident scenarios for commercial spent fuel, 6:16557 (SAND—80-2124)

SPENT FUEL STORAGE
Spent fuel dry storage technology development: report of consolidated thermal data, 6:16554 (DOE/NV/00597—6)
Research Programs
Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)

SPENT FUELS
Accidents
Report on a workshop on transportation-accident scenarios involving spent fuel, 6:16556 (SAND—80-2012)
Packaging
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Transport
Report on a workshop on transportation-accident scenarios involving spent fuel, 6:16556 (SAND—80-2012)
Transportation accident scenarios for commercial spent fuel, 6:16557 (SAND—80-2124)

SPHERATOR
Reactor Start-Up
Start-up scenario of compact tori based on REB-injection developed in SPAC-group, 6:17868 (PPPL—1755)

SPHEROMAK DEVICES
All plasma spheromak: the plasmak, 6:17875 (PPPL—1755)
Preliminary studies of spheromak reactors, 6:17874 (PPPL—1755)
Results and present status of the relativistic electron ring experiments and their application to Spheromak problems, 6:17850 (PPPL—1755)
Spheromak formation by theta pinch, 6:17858 (PPPL—1755)
SPS compact torus experiment, 6:17869 (PPPL—1755)
Design
Design and fabrication of the S-1 spheromak device, 6:17865 (PPPL—1755)
Equilibrium Plasma
Compact toroidal plasma equilibrium and implications on stability, 6:17794 (PPPL—1755)
Hybrid Systems
Stellarmak a hybrid Stellarator: Spheromak, 6:17861 (PPPL—1755)
Impurities
Effects of impurity radiation on reversed-field pinch evolution, 6:17784 (PPPL—1755)
Magnetic Field Configurations
Minimum energy equilibria, 6:17870 (PPPL—1755)
Magnetic Flux
Spheromak equilibrium and stability and numerical studies of a spheromak formation scheme, 6:17864 (PPPL—1755)
Mathematical Models
Two-dimensional simulation of the formation of the PPPL spheromak, 6:17866 (PPPL—1755)
Plasma Instability
Compact toroidal plasma equilibrium and implications on stability, 6:17794 (PPPL—1755)
Reviews
Compact torus concept and the spheromak, 6:17842 (PPPL—1755)
LASL Compact Torus Program, 6:17843 (PPPL—1755)
Specifications
Dynamically formed spheromak plasma (PS-1), 6:17863 (PPPL—1755)
Toroidal Configuration
Holomak: a toroidal spheromak, 6:17872 (PPPL—1755)

SPIN GLASS STATE
Propagation of sound in a spin-glass, 6:17753

SPOIL BANKS
Stability
Surface mine spoil stability evaluation, interior coal province. Volume I-main report. Glossary of terms (appendix a) and annotated bibliography (appendix b). Contract research (final), September 1977-January 1979, 6:16408 (PB—80-211113)
Surface mine spoil stability evaluation, interior coal province. Volume II-details of mine visits and detailed procedures of laboratory testing (appendix c). Contract research (final), September 1977-January 1979, 6:16409 (PB—80-211121)

SQUID DEVICES
Noise
Quantum noise theory for the dc SQUID, 6:17217

SRC PROCESS
Corrosion
Stress-corrosion cracking studies in coal-liquefaction systems, 6:16345 (CONF-810402—9)
Demonstration Plants
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow columns). Quarterly technical progress report, 1 April 1980-30 June 1980, 6:16353 (DOE/ET/14801—9)
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow column), 6:16352 (DOE/ET/14801—6)
Fluid Mechanics
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow columns). Quarterly technical progress report, 1 April 1980-30 June 1980, 6:16353 (DOE/ET/14801—9)
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow column), 6:16352 (DOE/ET/14801—6)
Mass Transfer
Gas/slurry flow in coal-liquefaction processes (fluid dynamics in 3-phase flow columns). Quarterly technical progress report, 1 April 1980-30 June 1980, 6:16353 (DOE/ET/14801—9)
Materials Testing
Stress-corrosion cracking studies in coal-liquefaction systems, 6:16345 (CONF-810402—9)

STABILITY
Correlations
Functional complexity and ecosystem stability, 6:17398

STACKING FAULTS
Electronic Structure
Electronic structure of the rotation twin stacking fault in β-ZnS, 6:17126

STACKS
Air Pollution Abatement
Flue-gas conditioning to reduce particulate emissions in industrial coal-fired boilers, 6:17004 (CONF-800483—(Vol.2))

STAINLESS STEEL-304
Brazing
Metallurgical study for University of California Lawrence Livermore Labs. (SS 304 to 21-6-9), 6:17116 (UCRL—15318)
Corrosion
Corrosion of metals in coal char environments (FMC, Husky, and Synthane chars), 6:16379 (LBL—12152)
Stress Corrosion
Localized corrosion and stress-corrosion cracking behavior of stainless steel weldments. Annual progress report, June 1, 1980-February 28, 1981, 6:17087 (DOE/ER/02462—T1)

STAINLESS STEEL-304L
Corrosion Fatigue
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)

STAINLESS STEEL-308
Pitting Corrosion
Localized corrosion and stress-corrosion cracking behavior of stainless steel weldments. Annual progress report, June 1, 1980-February 28, 1981, 6:17087 (DOE/ER/02462—T1)

STAINLESS STEEL-316
Ductility
Mechanical properties of type 316 stainless steel materials after irradiation at 515°C and 585°C, 6:16843 (HEDL-TME—81-4)
Joining
Inelastic behavior of a dissimilar-metal-welded pipe transition joint: comparison of experimental measurements and analytical prediction, 6:16840 (GEFR-SP—148)
Mechanical Properties
Alloy development for irradiation performance in fusion reactors. Annual report, September 1979-September 1980, 6:17832 (DOE/ER/10107—1)
Physical Radiation Effects
Alloy development for irradiation performance in fusion reactors. Annual report, September 1979-September 1980, 6:17832 (DOE/ER/10107—1)
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
Impact of advanced microstructural characterization techniques on modeling and analysis of radiation damage, 6:17100 (HEDL-SA—1936)
Mechanical properties of type 316 stainless steel materials after irradiation at 515°C and 585°C, 6:16843 (HEDL-TME—81-4)
Tensile Properties
Mechanical properties of type 316 stainless steel materials after irradiation at 515°C and 585°C, 6:16843 (HEDL-TME—81-4)
Welded Joints
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)

STAINLESS STEELS
STAINLESS STEEL-304
See also STAINLESS STEEL-304L
STAINLESS STEEL-308
STAINLESS STEEL-316
Brazing
Metallurgical study for University of California Lawrence Livermore Labs. (SS 304 to 21-6-9), 6:17116 (UCRL—15318)
Emissivity
Thermal-performance study of liquid metal fast breeder reactor insulation, 6:16837 (ANL—80-97)
Joining
Glass ceramics for sealing to high-thermal-expansion metals, 6:17143 (SAND—80-2192)
Stress Corrosion
Stress-corrosion cracking studies in coal-liquefaction systems, 6:16345 (CONF-810402—9)
Welded Joints
X-ray diffraction study of residual stress in model weldments. Final report, 6:17109 (UCRL—15332)

STANDARDS (CALIBRATION)
See CALIBRATION STANDARDS

STANDARDS (SAFETY)
See SAFETY STANDARDS

STANDING CROP
See BIOMASS

STATISTICS
Algorithms
Computing percentiles of large data sets, 6:17897 (LA-UR—81-1024)

STEAM
Consumption Rates
Hartford Steam Service Company: annual business report for 1979, 6:17052
Market
Statistical committee report of industry statistics for 1979, 6:17038
Profits
Hartford Steam Service Company: annual business report for 1979, 6:17052

STEAM GENERATION
See also COGENERATION

Computerized Control Systems
Industrial-boiler optimization utilizing CO control, 6:17018 (CONF-800483—(Vol.2))
Cost
Statistical committee report of industry statistics for 1979, 6:17038
Fuel Consumption
Statistical committee report of industry statistics for 1979, 6:17038
Statistics
Statistical committee report of industry statistics for 1979, 6:17038

STEAM GENERATORS
Corrosion
Situ corrosion monitoring of steam generators, 6:16832
Fluidized-Bed Combustors
Operating experience of a coal-fired fluidized bed at Georgetown, University, 6:16958 (CONF-800483—(Vol.2))

STEAM INJECTION
Mathematical Models
Scaled physical model studies of the steam drive process. Second annual report, September 1978-September 1979, 6:16486 (DOE/ET/12075—2)
Research Programs
Scaled physical model studies of the steam drive process. Second annual report, September 1978-September 1979, 6:16486 (DOE/ET/12075—2)

STEAM SYSTEMS
Capacity
Hartford Steam Service Company: annual business report for 1979, 6:17052
Control Equipment
Red-tagging safety procedure for a steam distribution system, 6:17233
Energy Analysis
Analysis and development of large industrial steam systems, 6:16997 (CONF-800483—(Vol.2))
Flowmeters
Novel approach to field testing shunt-flow steam meters, 6:17039
Safety Engineering
Red-tagging safety procedure for a steam distribution system, 6:17233
Systems Analysis
Analysis and development of large industrial steam systems, 6:16997 (CONF-800483—(Vol.2))

STEEL-ASTM-A533
Fracture Properties
Development of a plastic fracture methodology. Final report, 6:16849 (EPRI-NP—1734)

STEELS
See also CARBON STEELS
STAINLESS STEELS
STEEL-ASTM-A533
Crack Propagation
Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II (HSLA steels; Ti-30 Mo), 6:17095 (DOE/ER/10433—2)
Fatigue
Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II (HSLA steels; Ti-30 Mo), 6:17095 (DOE/ER/10433—2)
Gas Tungsten-Arc Welding
Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)

STELLARATORS
See also SPHERATOR
Hybrid Systems
Stellarmak a hybrid Stellarator: Spheromak, 6:17861 (PPPL—1755)

STH
(Somatotropic hormone; growth hormone.)
Biological Functions
Growth hormone and somatomedins, 6:17482
Molecular Structure
Growth hormone and somatomedins, 6:17482

STIRLING ENGINES
Design
Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-horsepower range. Phase I final report, 6:16785 (DOE/ET/15208—T1(Vol.2))
Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-hp range. Phase I final report, 6:16784 (DOE/ET/15208—T1(Vol.1))
Economic Analysis
Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-horsepower range. Phase I final report, 6:16785 (DOE/ET/15208—T1(Vol.2))
Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-hp range. Phase I final report, 6:16784 (DOE/ET/15208—T1(Vol.1))
Performance
Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-horsepower range. Phase I final report, 6:16785 (DOE/ET/15208—T1(Vol.2))
Design and development of Stirling engines for stationary-power-generation applications in the 500- to 3000-hp range. Phase I final report, 6:16784 (DOE/ET/15208—T1(Vol.1))

STORAGE RINGS
See also CESR STORAGE RING
ISABELLE STORAGE RINGS
LEP STORAGE RINGS
PEP STORAGE RINGS
PETRA STORAGE RING
SPEAR
Beam Dynamics
Los Alamos proton-storage-ring extraction system, 6:17259 (LA-UR—81-784)
Control Systems
Novel current monitor for DC and modulated magnets in the proton storage ring, 6:17299 (LA-UR—81-781)
Free Electron Lasers
Free electron laser experiment at the NSLS 700 MeV electron storage ring, 6:17291 (BNL—29209)
Proton Beams
Los Alamos proton-storage-ring extraction system, 6:17259 (LA-UR—81-784)
RF Systems
Pulsed rf operation analysis, 6:17296 (BNL—29241)

STORAGE (SPENT FUEL)
See SPENT FUEL STORAGE

STORAGE TUBES
See ELECTRON TUBES

STORMS
See also HURRICANES
Simulation
Moving boundary storm surge modelling with numerical methods (Water-land interface), 6:17431 (ORNL—5611)

STRAND BREAKS
Radioinduction
DNA repair in a short- and a long-lived rodent species, 6:17521

STRATEGIC PETROLEUM RESERVE
Strategic Petroleum Reserve annual report, 6:16505 (DOE/RA—0047/1)

STRATOSPHERE
Bromine
First measurements of total chlorine and bromine in the lower stratosphere, 6:17566
Chlorine
First measurements of total chlorine and bromine in the lower stratosphere, 6:17566

STRAW
Fermentation
Increasing the value of straw by fermentation, 6:16652 (PB—80-207939)
Hydrolysis
Increasing the value of straw by fermentation, 6:16652 (PB—80-207939)

Pyrolysis
Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)
Pyrolysis Products
Experimental investigation into fast pyrolysis of biomass using an entrained-flow reactor, 6:16661 (SERI/TR—631-1004)
Uses
Increasing the value of straw by fermentation, 6:16652 (PB—80-207939)

STREAMS
Mathematical Models
SEAP: a computer program for the error analysis of a stream model, Monte Carlo methodology and program documentation, 6:17432 (ORNL/TM—7654)
Radionuclide Migration
Transuranics in a stream near a nuclear-fuel chemical separations plant, 6:17440 (DP—1592)

STRONTIUM
Atom-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)
Ion-Atom Collisions
H^- production in H^+ and H^0 collisions with alkaline-earth metal vapors, 6:17576 (BNL—51304)

STRONTIUM 82
Decay
High-resolution positron Q-value measurements and nuclear-structure studies far from the stability line. Progress report, 6:17723 (DOE/ER/10434—2)

STRONTIUM 90
Decontamination
Russian experience, 6:17402 (CONF-791234—)
Energy Levels
Decay of ^{90}Rb/sup g/ and ^{90}Rb/sup m/, 6:17715
Radioecological Concentration
Reassessment of the potential radiological doses for residents resettling Enewetak Atoll, 6:17422 (UCRL—53066)
Radioisotope Heat Sources
Quarterly report on the strontium heat source development program, advanced nuclear systems and projects division for October-December 1980, 6:16591 (PNL—1845-49)

STRONTIUM SULFATES
Solubility
Thermodynamics of geothermal fluids, 6:16763 (LBL—12356)

STRUCTURE (CRYSTAL)
See CRYSTAL STRUCTURE

STRUCTURES (MECHANICS)
See MECHANICAL STRUCTURES

STYRENE
Dielectric Properties
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
Mechanical Properties
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)

SUDAN
Energy Consumption
Household energy use in non-OPEC developing countries, 6:16977 (RAND/R—2515-DOE)

SUGAR BEETS
Waste Processing
Production of biogas from waste waters of food-processing indusries, 6:16990 (CONF-800483—(Vol.2))

SULFATES
Metabolism
Regulatory coupling of nitrate and sulfate assimilation pathways in cultured tobacco cells, 6:17474

SULFOCYANIDES
See THIOCYANATES

SULFONATES
Adsorption
Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs (Surfactants - carboxymethylized oxyethylate, naphthenic acid betaine, alkylsulfonate), 6:16472 (CONF-8004140—)

SULFONES
Physical Radiation Effects
Radiation response and electrical properties of polymer energy-storage capacitors: PVF_2, polysulfone, and Mylar, 6:16877 (SAND—81-0067C)

SULFUR
Recovery
Section I: high-temperature desulfurization of fuel gases, 6:16376 (FE—2806-16)

SULFUR 32
Isotope Separation
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))

SULFUR 34
Isotope Separation
Separation of the stable isotopes of Cl, S and Ca, 6:17168 (MLM—2815(OP))
Uses
Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497

SULFUR 35
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)

SULFUR COMPLEXES
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)

SULFUR DIOXIDE
Air Pollution Control
Review of new source performance standards for coal-fired utility boilers, phase three report, sensitivity studies for the selection of a revised standard. Final report, 6:16797 (PB—80-213036)
Biological Effects
Ecological behavior and effects of energy-related pollutants. Progress report, November 1, 1979-January 31, 1981, 6:17531 (DOE/EV/02412—105)
Deposition
Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978, 6:17384 (PB—80-205792)
Ecological Concentration
Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978, 6:17384 (PB—80-205792)
Phase Studies
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)
Removal
Aqueous carbonate process test requirements document. Final report, 6:16407 (EPRI-CS—1738)
Coal gasification pilot plant support studies. Subtask 3-3. Improved methods of removal, recovery, or conversion of sulfur and nitrogen compounds in raw product gases from coal gasification processes, 6:16375 (FE—2806-16)
Pessel-AEL flue-gas desulfurization process. Final report, 6:16404 (DOE/IR/06355—T1)
Scrubber-generated particulate: literature survey. Final report, 6:17352 (EPRI-CS—1739)
Section I: high-temperature desulfurization of fuel gases, 6:16376 (FE—2806-16)
Viscosity
Phase equilibria of petroleum hydrocarbons with carbon dioxide and sulfur dioxide, 6:16475 (CONF-8004140—)

SULFUR FLUORIDES
Infrared Spectra
Matrix—molecule interactions, dynamics, and exchange phenomena in low temperature matrices: SF_6 in argon and krypton, 6:17609
Matrix Isolation
Matrix—molecule interactions, dynamics, and exchange phenomena in low temperature matrices: SF_6 in argon and krypton, 6:17609

SULFUR HYDRIDES
See HYDROGEN SULFIDES

SULFUR ISOTOPES
Isotope Separation
Generalized computer model of the transient behavior of multicomponent isotope-separation cascades, 6:16550 (MLM—2816(OP))
SULFUR OXIDES
Air Pollution Control
Thirty-day field tests of industrial boilers: site 1 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17243 (PB—80-211386)
Thirty-day field tests of industrial boilers: site 3 - pulverized-coal-fired boiler. Final report, March 1979-March 1980, 6:17246 (PB—80-219512)
Thirty-day field tests of industrial boilers: site 4 - coal-fired spreader stoker. Final report, March 1979-March 1980, 6:17247 (PB—80-219520)
SULFURIC ACID
Biological Effects
Biochemical effects of inhalation of sulfuric acid mist by human subjects while at rest. Report for 15 January-1 May 1979, 6:17534 (PB—80-210552)
Removal
Pessel-AEL flue-gas desulfurization process. Final report, 6:16404 (DOE/IR/06355—T1)
SUMMER-1 REACTOR
Personnel
Health physics training at V.C. Summer Nuclear Station, 6:16831 (CONF-810411—)
Radiation Protection
Health physics training at V.C. Summer Nuclear Station, 6:16831 (CONF-810411—)
SUPERCONDUCTING CABLES
Performance Testing
LASL Nb_3Ge conductor development. Sixteenth quarterly progress report, April 1-June 30, 1980, 6:16812 (LA—8606-PR)
Research Programs
LASL Nb_3Ge conductor development. Sixteenth quarterly progress report, April 1-June 30, 1980, 6:16812 (LA—8606-PR)
SUPERCONDUCTING DEVICES
See also SQUID DEVICES
SUPERCONDUCTING MAGNETS
Bibliographies
Superconducting devices and materials. A literature survey issued quarterly, July-September 1980. Issue No. 80-03, 6:17210
SUPERCONDUCTING MAGNETS
Configuration
Upgraded coil configuration for ISABELLE magnets, 6:17297 (BNL—29307)
Magnet Coils
Upgraded coil configuration for ISABELLE magnets, 6:17297 (BNL—29307)
Mechanical Tests
Mechanical properties of ISABELLE superconducting coils, 6:17295 (BNL—29236)
Performance Testing
First cell magnet system tests, 6:17294 (BNL—29232)
Power Supplies
ISABELLE magnet power supply system performance analysis, 6:17286 (BNL—29188)
Specifications
ISABELLE magnet power supply system performance analysis, 6:17286 (BNL—29188)
Test Facilities
Operation of the 8-T, 1-m-diameter test facility at Lawrence Livermore National Laboratory, 6:17887 (UCRL—85073)
SUPERCONDUCTORS
Bibliographies
Superconducting devices and materials. A literature survey issued quarterly, July-September 1980. Issue No. 80-03, 6:17210
Uses
Superconducting devices and materials. A literature survey issued quarterly, July-September 1980. Issue No. 80-03, 6:17210
SUPERCRITICAL FLOW
See TURBULENT FLOW
SUPERNOVA REMNANTS
Gamma Radiation
Very high energy gamma ray astrophysics. Progress report, August 1, 1980-July 31, 1981, 6:17561 (DOE/ER/10774—1)
SURFACE CLEANING
Textiles
Clean room wiping cloths, 6:17205 (BDX—613-2566)
SURFACE COATING
Comparative Evaluations
Commercial applications of overlay coating techniques, 6:17077 (SAND—81-0570C)
SURFACE CONTAMINATION
Decontamination
New decontamination technologies for environmental applications, 6:16581 (CONF-791234—)
Removal
Techniques for removing contaminated concrete surfaces, 6:17416 (CONF-791234—)
SURFACE CONTAMINATION MONITORS
Design
Soil monitoring instrumentation, 6:17403 (CONF-791234—)
SURFACE FINISHING
See also SURFACE CLEANING
Defects
Burrs formed in producing small holes, 6:17107 (RFP—3195)
SURFACE MINING
See also COAL MINING
Accidents
Even the safest-looking highwall may be as lethal as a rattlesnake, 6:16438
Economics
Methods and costs of thin-seam mining. Final report, 25 September 1977-24 January 1979 (Thin seam in association with a thick seam), 6:16426 (DOE/ET/12543—1)
Mining Equipment
Methods and costs of thin-seam mining. Final report, 25 September 1977-24 January 1979 (Thin seam in association with a thick seam), 6:16426 (DOE/ET/12543—1)
Safety
Cooperation, commitment add up to worker safety at two mines, 6:16437
Slope Stability
Even the safest-looking highwall may be as lethal as a rattlesnake, 6:16438
Water Pollution
Coal and the environment abstract series: mine drainage bibliography 1929-1980. Final report, 6:16416 (PB—80-221062)
SURFACE-ACTIVE AGENTS
See SURFACTANTS
SURFACTANTS
Adsorption
Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—)
International Energy Agency workshop on enhanced oil recovery, 6:16466 (CONF-8004140—)
Laboratory investigations for the determination of critical conditions for displacement processes in oil reservoirs (Surfactants - carboxymethylized oxyethylate, naphthenic acid betaine, alkylsulfonate), 6:16472 (CONF-8004140—)
Partition
Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study, 6:17191
Radiolysis
Rate of exchange of surfactant monomer radicals and long chain alcohols between micelles and aqueous solutions. A pulse radiolysis study, 6:17191
Solubility
Adsorption of pure surfactant and petroleum sulfonate at the solid-liquid interface, 6:16471 (CONF-8004140—)
SUSPENSIONS (FUEL)
See FUEL SLURRIES

SWAMPS
Floods
Increased cesium uptake by water tupelo under inundated conditions, 6:17443
SWEDEN
Earthquakes
Swedish earthquakes and acceleration probabilities, 6:17549 (FOA-C—20295-E4)
SYMBIOSIS
Biological Effects
Light-shade adaptation of Stylophora pistillata, a hermatypic coral from the Gulf of Eilat, 6:17426
SYNROC PROCESS
Application of SYNROC to high-level defense wastes, 6:16572 (UCRL—85032)
Powders
Preparation history and analytical results for synroc powders: hollandite (SO3), nepheline (SO8), and synroc C (SO4, SO5, SO6, SO9), 6:16571 (UCID—18845)
SYNTHESIS GAS
Production
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
SYNTHETIC FUELS INDUSTRY
Employment
Labor productivity in heavy construction: impact on synfuels program employment, 6:17447 (ANL/AA—24)

T

T INVARIANCE
Theoretical studies of high-energy phenomena: analysis of models of CP and T violation. Progress report, February 15, 1980-April 30, 1981, 6:17671 (DOE/ER/10587—1)
T3 HORMONE
See TRIIODOTHYRONINE
T4 HORMONE
See THYROXINE
TADPOLES
See LARVAE
TANTALUM 181 TARGET
Argon 40 Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
Krypton 86 Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
Xenon 136 Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
TAR SANDS
See OIL SANDS
TATB
(1,3,5-Triamino-2,4,6-trinitrobenzene.)
Quality Control
High Z (ash) analysis of TATB, 6:17338 (MHSMP—81-10)
X-Ray Spectroscopy
High Z (ash) analysis of TATB, 6:17338 (MHSMP—81-10)
TAU NEUTRINOS
Weak Interactions
Neutrinos and neutrino interactions, 6:17659 (SLAC—239)
TEARING INSTABILITY
Observations of plasma tearing instabilities and associated axial translation in field-reversed experiments, 6:17765 (LA—8729-MS)
Analytical Solution
Tearing-mode stability analysis of a cylindrical plasma, 6:17789 (PPPL—1755)
Nonlinear Problems
Nonlinear theory of high-m tearing modes, 6:17805
Numerical Solution
3-D nonlinear calculations of resistive tearing modes, 6:17771 (ORNL/TM—7132)
TECHNETIUM
Chemistry
Studies in technetium chemistry. Progress report, 6:17193 (DOE/EV/04115—4)
Coordination Number
Studies in technetium chemistry. Progress report, 6:17193 (DOE/EV/04115—4)
Oxidation
Studies in technetium chemistry. Progress report, 6:17193 (DOE/EV/04115—4)
TECHNETIUM 99
Chemistry
Studies in technetium chemistry. Progress report, 6:17193 (DOE/EV/04115—4)
Comparative Evaluations
Design and synthesis of new radiopharmaceuticals, 6:17194 (DOE/EV/04115—4)
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Scintiscanning
Cardiac imaging agents: derivatives of β-adrenergic blocking agents, 6:17195 (DOE/EV/04115—4)
TECHNOLOGY ASSESSMENT
Review of technology for Arctic offshore oil and gas recovery, 6:16487 (DOE/ET/14317—T2(Vol.1))
Computer Codes
Modeling in peat gasification, 6:16612 (TR—80/031-001)
Evaluation
Application of a methodology for evaluation of intertechnology tradeoffs: an illustrative case study, 6:16899 (ANL/EES-TM—127)
Research Programs
Energy Analysis Program, FY 1980, 6:16888 (LBL—11972)
Technology assessments, 6:16889 (LBL—11972)
TECHNOLOGY TRANSFER
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
TECHNOLOGY UTILIZATION
Evaluation
Application of a methodology for evaluation of intertechnology tradeoffs: an illustrative case study, 6:16899 (ANL/EES-TM—127)
TELESCOPE COUNTERS
Mass Resolution
Neutron induced charged particle reaction studies at Ohio University, 6:17703 (DOE/NDC—21/L(Vol.1))
TELLURIC SURVEYS
Data Analysis
Telluric-magnetotelluric method in two- and three-dimensional environments, 6:16732 (DOE/ET/28392—25)
TELLURIUM
Energy Levels
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region (Petrovich-McManus-Madsen effective interaction), 6:17717
TELLURIUM 123
Radioisotope Scanning
Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C, 6:17198 (DOE/EV/04115—4)
Radiopharmaceuticals
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
Scintiscanning
Nuclear medicine technology progress report for quarter ending September 30, 1980, 6:17199 (ORNL/TM—7605)
TELLURIUM 133
Energy Levels
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region, 6:17717
TEMPERATURE (AMBIENT)
See AMBIENT TEMPERATURE
TEMPERATURE (BODY)
See BODY TEMPERATURE

TENNESSEE
See also OAK RIDGE
Industrial Plants
Field-tested model of industrial energy-conservation assistance to small industries, 6:17024 (CONF-800483—(Vol.2))
Water Resources
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)
Water resources appraisals for hydroelectric licensing: Cumberland River Basin, Kentucky and Tennessee. Planning status report, 6:16624 (FERC—0077)
TENNESSEE RIVER
Hydroelectric Power Plants
Water resources appraisals for hydroelectric licensing: Tennessee River Basin, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, and Alabama. Planning status report, 6:16621 (FERC—0074)
Water Resources
Water resources appraisals for hydroelectric licensing: Tennessee River Basin, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, and Alabama. Planning status report, 6:16621 (FERC—0074)
TERRESTRIAL ECOSYSTEMS
See also SWAMPS
Dynamic Function Studies
Functional complexity and ecosystem stability, 6:17398
TEST FACILITIES
See also CENTRAL RECEIVER TEST FACILITY
Design
Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)
Site Selection
Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)
Specifications
Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)
TETRAHYDRONAPHTHALENE
See TETRALIN
TETRALIN
Isomerization
Radical pathways of coal dissolution in hydrogen donor media. 2. β scission and 1,2 aryl migration reactions of radicals derived from methylindans and tetralin at 327 to 627°C, 6:17183
TEXACO GASIFICATION PROCESS
Comparative Evaluations
Impact of developing technology on indirect liquefaction, 6:16347 (DOE/ET/10280—T1)
TEXAS
Energy Efficiency
Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2))
Energy Supplies
Energy research, development, and demonstration, 6:16900 (CONF-800483—(Vol.2))
Geochemical Surveys
Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16536 (GJBX—29(80)(Pt.7))
Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16535 (GJBX—29-80(Pt.6))
Industrial Plants
Energy technical assistance: industrial processes program, 6:17054 (CONF-800483—(Vol.2))
Small Businesses
Energy technical assistance: industrial processes program, 6:17054 (CONF-800483—(Vol.2))
Water Resources
Evaluation of the impact of Texas lignite development on Texas water resources. Technical completion report, 1 July 1976-30 September 1977, 6:16415 (PB—80-220635)
Wind Power
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
TEXTILE INDUSTRY
Boilers
Wood-coal fired small boiler case study, 6:16996 (CONF-800483—(Vol.2))
TEXTILES
Performance
Clean room wiping cloths, 6:17205 (BDX—613-2566)
Processing
Optimization of energy usage in textile finishing operations. Part I. The simulation of batch dyehouse activities with a general purpose computer model, 6:17035 (DOE/CS/40092—T1)
TFTR REACTORS
Research Programs
Annual report, October 1, 1978-September 30, 1979, 6:17880 (PPPL-Q—37)
THALLIUM
Muonic Atoms
Investigation of the $^{203\ 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
THALLIUM 189
Energy Levels
Nuclear spectroscopic studies. Progress report, June 1, 1980-May 31, 1981, 6:17722 (DOE/ER/04936—6)
THALLIUM 201
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
THALLIUM 203
Energy Levels
Investigation of the $^{203\ 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
THALLIUM 203 TARGET
Neutron Reactions
Investigation of the $^{203\ 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
THALLIUM 205
Energy Levels
Investigation of the $^{203\ 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
THALLIUM 205 TARGET
Neutron Reactions
Investigation of the $^{203\ 205}$Tl level schemes after (n,n'gamma) reactions at 2.75 MeV, 6:17728 (PB—80-213002)
THERMAL DECOMPOSITION
See PYROLYSIS
THERMAL EFFLUENTS
Environmental Impacts
Evaluation of Toledo Edison Company's 316(a) and 316(b) demonstrations for the Bay Shore Station (Analysis of impacts of thermal discharge on Maumee Bay and analysis of impact of entrainment and impingement on fish communities), 6:17524 (PNL—3409)
Environmental Transport
AT123D: analytical transient one-, two-, and three-dimensional simulation of waste transport in the aquifer system, 6:17435 (ORNL—5602)
THERMAL ENERGY STORAGE EQUIPMENT
Computer Codes
COMMIX-SA-1: a three-dimensional thermohydrodynamic computer program for solar applications (Heat-storage water tanks), 6:16724 (ANL—80-8)
THERMAL INSULATION
See also MINERAL WOOL
Performance
Evaluation of silicone foam for flat plate solar collector insulation, 6:16722
Thermal-performance study of liquid metal fast breeder reactor insulation, 6:16837 (ANL—80-97)
Physical Properties
Evaluation of silicone foam for flat plate solar collector insulation, 6:16722
R Factors
Reduction in the thermal resistance (R-value) of loose-fill insulation and fiberglass batts due to compression, 6:16966 (ORNL/Sub—7715/2)

Thickness
Reduction in the thermal resistance (R-value) of loose-fill insulation and fiberglass batts due to compression, 6:16966 (ORNL/Sub—7715/2)

THERMAL POWER PLANTS
See also COMBINED-CYCLE POWER PLANTS
FOSSIL-FUEL POWER PLANTS
GEOTHERMAL POWER PLANTS
NUCLEAR POWER PLANTS
REFUSE-FUELED POWER PLANTS
WOOD-FUEL POWER PLANTS
Water resources appraisals for hydroelectric licensing: Cumberland River Basin, Kentucky and Tennessee. Planning status report, 6:16624 (FERC—0077)

Cooling Towers
Optimum mechanical draft wet cooling towers to supplement once-through cooling at selected Missouri River sites, 6:16789 (PB—80-212764)

Environmental Impacts
Fish community studies in the Patuxent estuary, 1978-79. Final report, April 1976-March 1979, 6:17523 (PB—80-209976)

Water Requirements
Planning status report. Water resources appraisals for hydroelectric licensing: Colorado River Basin, Texas, 6:16626 (FERC—0079)
Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report, 6:16620 (FERC—0073)
Water resources appraisals for hydroelectric licensing: Tennessee River Basin, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, and Alabama. Planning status report, 6:16621 (FERC—0074)
Water resources appraisals for hydroelectric licensing: American River Basin, California. Planning status report, 6:16623 (FERC—0076)
Water resources appraisals for hydroelectric licensing: Tombigbee-Warrior River Basin, Alabama and Mississippi. Planning status report, 6:16625 (FERC—0078)

THERMAL WATERS
Environmental Impacts
Thermal ecology: environmental teachings of a nuclear reactor site, 6:17444

THERMIONIC DIODES
(A device through which current may pass by virtue of thermionic emission of electrons or ions or both.)
Charged-Particle Transport
Theoretical analysis of ARC constriction, 6:16945 (DOE/ET/15422—6)
Plasma Sheath
Theoretical analysis of ARC constriction, 6:16945 (DOE/ET/15422—6)

THERMOCHEMICAL PROCESSES
Comparative Evaluations
Modeling in peat gasification, 6:16612 (TR—80/031-001)
Economic Analysis
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)
Reviews
Biomass energy enhancement, 6:16649
Technology Assessment
Biomass energy enhancement, 6:16649
Energy from biological processes. Volume II. Technical and environmental analyses, 6:16650 (OTA-E—128)

THERMOCOUPLES
Accuracy
Assessment of the influence of surface thermocouples on the behavior of nuclear fuel rods during a large break LOCA, 6:16860 (CONF-801053—11)

THERMOLUMINESCENT DOSEMETERS
Calibration
Extremity dosimeter studies, 6:17314 (PNL—3536)
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Introduction, 6:17306 (PNL—3536)
Design
Dosimeter design specifications, 6:17307 (PNL—3536)
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Energy Dependence
Extremity dosimeter studies, 6:17314 (PNL—3536)
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Neutron response study, 6:17308 (PNL—3536)
Evaluation
High energy photon response, 6:17309 (PNL—3536)
Filtration
Dosimeter design specifications, 6:17307 (PNL—3536)
Response Functions
Environmental effects on the Hanford Multipurpose Personnel Dosimeter, 6:17313 (PNL—3536)
Extremity dosimeter studies, 6:17314 (PNL—3536)
Hanford Personnel Dosimeter supporting studies FY-1980 (Lead abstract), 6:17305 (PNL—3536)
Statistical and low dose response, 6:17315 (PNL—3536)
Sensitivity
Phantom position dependence, 6:17312 (PNL—3536)
Specifications
Dosimeter design specifications, 6:17307 (PNL—3536)
Temperature Effects
Extremity dosimeter studies, 6:17314 (PNL—3536)

THERMOMETERS
See also NOISE THERMOMETERS
Very Low Temperature
Mound Facility activities in chemical and physical research: July-December 1980, 6:16589 (MLM—2809)

THERMONUCLEAR DEVICES
See also CLOSED PLASMA DEVICES
STELLARATORS
TOKAMAK DEVICES
Electron Beam Injection
Experiment on plasma confinement by intense relativistic electron beam ring, 6:17775 (PPPL—1755)
Injection of relativistic electron beam into toroidal systems (Compact torus), 6:17844 (PPPL—1755)
Intense relativistic electron beams in toroidal magnetic geometries (Compact torus), 6:17846 (PPPL—1755)
Reversed-field configuration with rotating relativistic electron beams, 6:17849 (PPPL—1755)
Meetings
Proceedings of the US-Japan joint symposium on compact toruses and energetic particle injection, 6:17841 (PPPL—1755)
Plasma Beam Injection
Formation of a compact torus using a toroidal plasma gun, 6:17778 (PPPL—1755)
Magnetized gun experiments, 6:17777 (PPPL—1755)
Research Programs
Compact torus research at UCI, 6:17847 (PPPL—1755)
Rotational Transform
Physics of the OHTE, 6:17853 (PPPL—1755)

THERMONUCLEAR REACTOR MATERIALS
Materials Testing
Alloy development for irradiation performance in fusion reactors. Annual report, September 1979-September 1980, 6:17832 (DOE/ER/10107—1)
Physics calculations for preliminary feasibility studies of fusion blanket testing in ETR, 6:17836 (EGG-PHYS—5392)
Neutron Dosimetry
Review of source characterization for fusion materials irradiations, 6:17274 (DOE/NDC—21/L(Vol.1))
Neutron Reactions
Helium generation cross sections for fast neutrons, 6:17707 (DOE/NDC—21/L(Vol.1))
Integral cross section measurements on (n,x) reactions induced by 30 MeV d(Be) break-up neutrons on FRT wall and structural materials, 6:17704 (DOE/NDC—21/L(Vol.2))
Physical Radiation Effects
Characterization of the Be(d,n) neutron field by passive dosimetry techniques, 6:17690 (DOE/NDC—21/L(Vol.1))
FMIT related problems: shielding and materials damage studies, 6:17683 (DOE/NDC—21/L(Vol.1))
Review of source characterization for fusion materials irradiations, 6:17274 (DOE/NDC—21/L(Vol.1))

Research Programs
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)

THERMONUCLEAR REACTORS
(For use in cases where certain aspects of either hypothetical or real thermonuclear reactors are discussed.)
See also DOUBLET REACTORS
FIELD-REVERSED MIRROR REACTORS
I-BEAM TYPE REACTORS
LASER FUSION REACTORS
LINUS REACTORS
TFTR REACTORS
TOKAMAK TYPE REACTORS

Design
Tract: a small fusion reactor based on a compact torus plasma, 6:17879 (PPPL—1755)

Diode Tubes
Inverse ion diode experiment, 6:17815

Environmental Effects
Analysis of fusion fuel cycles, 6:17460 (PNL—3700(Pt.5))

Information Needs
US-Japan Workshop on atomic-collision data for fusion, 6:17773 (ORNL/TM—7675)

Process Heat
Applications of fusion thermal energy to industrial processes, 6:17829 (CONF-801210—24)

Regulatory Guides
Analysis of regulatory structure for a potential fusion-reactor industry, 6:17840 (PNL—3685)

Technology Assessment
Technology assessment, 6:17453 (PNL—3700(Pt.5))

THIO COMPOUNDS
See ORGANIC SULFUR COMPOUNDS

THIOCYANATES
Biodegradation
Bio-oxidation of thiocyanates typical of coal conversion effluents. Final report, 6:16402 (DOE/ET/04502—7)

THIRRING MODEL
Conservation Laws
Exact integrability in quantum field theory and statistical systems, 6:17678

Two-Dimensional Calculations
Exact integrability in quantum field theory and statistical systems, 6:17678

THORIUM
Proton Transport
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))

THORIUM 232 TARGET
Neutron Reactions
Measurement of neutron-transmission spectra through ^{232}Th from 8 MeV to 4 keV, 6:17734 (ORNL/TM—7661)
Thorium resonance-neutron capture (2.6 to 10 keV), 6:17735 (ORNL/TM—7732)

Proton Reactions
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))

THORIUM 233
Energy Levels
Thorium resonance-neutron capture (2.6 to 10 keV), 6:17735 (ORNL/TM—7732)

THORIUM ALLOYS
Magnetic Susceptibility
Superconductivity in filamentary eutectic composites. Progress report, June 1, 1980-May 31, 1981, 6:17754 (DOE/ER/04938—T1)

THORON
See RADON 220

THREE MILE ISLAND-2 REACTOR
Decontamination
TMI-2 Information and Examination Program, Technical Integration Office. Annual report, 6:16870 (EGG/GEND—003)

Radiation Monitoring
In situ measurement experiences, 6:17406 (CONF-791234—)
TMI-2 Information and Examination Program, Technical Integration Office. Annual report, 6:16870 (EGG/GEND—003)

Reactor Accidents
Controlling hydrogen behavior in light water reactors, 6:16873 (LA-UR—81-681)
Reporter at large: Three Mile Island. I. Class nine accident, 6:16876
TMI-2 Information and Examination Program, Technical Integration Office. Annual report, 6:16870 (EGG/GEND—003)

Reactor Operators
Post accident training program design at Three Mile Island, 6:16830 (CONF-810411—)

THYROID CELLS
Biological Radiation Effects
Photoreactivation of pyrimidine dimers in DNA from thyroid cells of the teleost, Poecilia formosa, 6:17522

THYROXINE
Side Effects
Thyroid hormone modulation of x-ray-induced in vitro neoplastic transformation, 6:17519

TIME PROJECTION CHAMBERS
See PROJECTION SPARK CHAMBERS

TIME-OF-FLIGHT METHOD
Reviews
Time-of-flight measurements, 6:17320 (SLAC—239)

TIME-OF-USE PRICING
Social Impact
Electric utility rate design study: costs and benefits of load management to society, 6:16933 (NP—22593)

TIME-REVERSAL INVARIANCE
See T INVARIANCE

TIME-SERIES ANALYSIS
Inductive modeling of time series: a detrending approach, 6:17893 (CONF-810436—1)

TIMING CIRCUITS
Performance Testing
Simple light-level recording device to monitor lighting in animal quarters, 6:17505

TIN 116 TARGET
Argon 40 Reactions
Nuclear research with heavy ions. Annual progress report. January 1, 1980-December 31, 1980, 6:17724 (DOE/ER/13246—20)

TIN ALLOYS
Electric Conductivity
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

Fabrication
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

Magnetic Properties
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

TIN COMPOUNDS
Fermi Level
Fermi-surface measurements of mixed-valent $CeSn_3$, 6:17112

TIN ISOTOPES
Energy Levels
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region (Petrovich-McManus-Madsen effective interaction), 6:17717

TISSUE CULTURES
Biological Regeneration
Cellular proliferation and regeneration following tissue damage. Final report, 6:17502 (DOE/EV/02401—T1)

Cell Proliferation
Cellular proliferation and regeneration following tissue damage. Final report, 6:17502 (DOE/EV/02401—T1)

TISSUE-EQUIVALENT DETECTORS
Calibration
Evaluate existing radiation fields, 6:17311 (PNL—3536)

Design
Evaluate existing radiation fields, 6:17311 (PNL—3536)

Operation
Evaluate existing radiation fields, 6:17311 (PNL—3536)

TITANIUM
Bibliographies
Titanium and titanium alloy creep. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17106 (PB—80-815244)
Corrosion
Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
Creep
Titanium and titanium alloy creep. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17106 (PB—80-815244)
Gas Tungsten-Arc Welding
Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)
Physical Radiation Effects
Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors, 6:17115
Tensile Properties
Corrosion testing of unalloyed titanium in simulated disposal environments for reprocessed nuclear waste. Final report, 6:16573 (PNL-TR—410)
TITANIUM 46
High Spin States
Nuclear structure of high-spin states in ^{46}Ti and ^{46}V, 6:17705
TITANIUM ALLOYS
See also TITANIUM BASE ALLOYS
Bibliographies
Titanium and titanium alloy creep. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17106 (PB—80-815244)
Corrosion
Preliminary conceptual designs for advanced packages for the geologic disposal of spent fuel, 6:16565 (PNL—2990)
Creep
Titanium and titanium alloy creep. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17106 (PB—80-815244)
Hydridation
Hydrogen absorption in metals: a field ion microscopy study. Progress report, June 1, 1980-May 31, 1981, 6:17094 (DOE/ER/10430—T1)
Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
Mechanical Properties
Materials studies for superconducting machinery coil composites. Interim report, 6:17104 (PB—80-212202)
Sorptive Properties
Investigation of the activation of iron-titanium-chrystals by means of metallography and hydrogen gassing, 6:17101 (Juel-Spez—52)
TITANIUM BASE ALLOYS
Crack Propagation
Microstructural approach to fatigue crack processes in polycrystalline bcc materials. Annual technical progress report II (HSLA steels; Ti-30 Mo), 6:17095 (DOE/ER/10433—2)
Fatigue
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
Physical Radiation Effects
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)
TITANIUM BORIDES
Physical Radiation Effects
Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors, 6:17115
TITANIUM CARBIDES
Creep
Inelastic deformation in crystalline non-metallic materials. Progress report, 6:17120 (DOE/ER/04441—4)
Hot Pressing
Inelastic deformation in crystalline non-metallic materials. Progress report, 6:17120 (DOE/ER/04441—4)
Physical Radiation Effects
Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors, 6:17115
TITANIUM OXIDES
Charged-Particle Transport
Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)
Damage
Determination of laser damage thresholds by comparison with an absolute laser damage standard, 6:17141
Laser Radiation
Determination of laser damage thresholds by comparison with an absolute laser damage standard, 6:17141
TITRATION
Remote Handling Equipment
Microcomputer-controlled remote pipetter: design and evaluation of a prototype system, 6:17158 (ORNL/TM—7608)
TMX DEVICES
ECR Heating
Tandem-mirror sloshing-electron plugs, 6:17820
Research Programs
Tandem mirror reactor studies at Lawrence Livermore National Laboratory, FY 1980, 6:17885 (UCID—18989)
TOKAMAK DEVICES
See also SPHEROMAK DEVICES
Ballooning Instability
High-n ballooning modes in highly elongated tokamaks, 6:17818
Drift Instability
Current-driven resistive drift instabilities in sheared magnetic fields, 6:17821
Electron Rings
Utilization of electron coils for an advanced Tokamak and conjecture about the cause for current step (down), 6:17862 (PPPL—1755)
Energy Balance
Passive thermal-stability control in ignited tokamaks by ripple transport and radial motion, 6:17822
Magnetic Field Configurations
Bifurcation of toroidal plasma in a poloidal quadrupole field, 6:17867 (PPPL—1755)
Plasma Macroinstabilities
MHD stability of vertically asymmetric tokamak equilibria, 6:17796 (PPPL—1766)
Synchrotron Radiation
Studies of emission and transport of synchrotron radiation in tokamaks, 6:17769 (LAPS—71)
Tearing Instability
3-D nonlinear calculations of resistive tearing modes, 6:17771 (ORNL/TM—7132)
Thermal Conduction
Passive thermal-stability control in ignited tokamaks by ripple transport and radial motion, 6:17822
TOKAMAK TYPE REACTORS
See also DOUBLET REACTORS
INTOR TOKAMAK
ISX TOKAMAK
TFTR REACTORS
Design
Wave-driver options for low-aspect-ratio steady-state tokamak reactors, 6:17826 (ANL/FPP/TM—141)
High-Frequency Heating
Wave-driver options for low-aspect-ratio steady-state tokamak reactors, 6:17826 (ANL/FPP/TM—141)
Impurities
Control of impurities in toroidal plasma devices (Patent), 6:17888
TOLUENE
Emission Spectra
Hydrocarbon plasma emission as a means to monitor plasma polymerization, 6:17131 (SAND—81-0806C)

Polymerization
Hydrocarbon plasma emission as a means to monitor plasma polymerization, 6:17131 (SAND—81-0806C)
TOPOGRAPHY
Corrections
Terrain correction program for gravity data: user's guide and documentation for Rev. 0), 6:17548 (DOE/ID/12079—26)
TOROIDAL PINCH DEVICES
Plasma Confinement
Formation of toroidal plasma confinement configurations by using hot electrons, 6:17779 (PPPL—1755)
TOTAL-ABSORPTION SPECTROMETERS
See SHOWER COUNTERS
TOWER FOCUS COLLECTORS
Materials Testing
Creep and the corrosion characteristics of Incoloy Alloy 800 in molten nitrate salts, 6:16719 (SAND—81-8665)
TOWER FOCUS POWER PLANTS
See also BARSTOW SOLAR PILOT PLANT
Feasibility Studies
Electricity generation by solar central receivers, 6:16682 (UCID—18977)
Heliostats
Second generation heliostat development for solar central receiver systems detailed design report. Volume II. Appendices, 6:16683 (SAND—79-8194(Vol.2)(App.))
Retrofitting
Look to the future: solar repowering for tomorrow's energy needs, 6:16676 (CONF-800483—(Vol.2))
TOXINS
See also HAZARDOUS MATERIALS
Inhibition
Effects of local anesthetics on cholinergic agonist binding affinity of central nervous system α-bungarotoxin receptors, 6:17478
TPC
See PROJECTION SPARK CHAMBERS
TRACER TECHNIQUES
Bibliographies
Selected bibliography of biomedical and environmental applications of stable isotopes V-^{2}H, ^{13}C, ^{15}N, ^{18}O, and ^{34}S, 1977-1978, 6:17497
TRADE
See also COMMERCIAL SECTOR
Global Aspects
INCHEM Tokyo 79, 6:16897
TRAINING
See EDUCATION
TRANSAMINASES
See AMINOTRANSFERASES
TRANSCRIPTION
Biochemical Reaction Kinetics
Immunoreactive helix-destabilizing protein localized in transcriptionally active regions of Drosophila polytene chromosomes, 6:17487
TRANSIENT SPECIES
See REACTION INTERMEDIATES
TRANSIENTS
Heat Transfer
Development of models for the sodium version of the two-phase three-dimensional thermal hydraulics code THERMIT (LMFBR), 6:16868 (DOE/ET/37218—3)
Hydraulics
Development of models for the sodium version of the two-phase three-dimensional thermal hydraulics code THERMIT (LMFBR), 6:16868 (DOE/ET/37218—3)
TRANSITION ELEMENT COMPOUNDS
Electronic Structure
Experimental investigation of the ionizations, electronic strucutre, and bonding of small molecules attached to transition metals. Progress report, 1 September 1980-1 April 1981, 6:17599 (DOE/ER/10746—T1)
TRANSMISSION LINES
See POWER TRANSMISSION LINES
TRANSONIC FLOW
Mathematical Models
Unsteady transonic flow past airfoils in rigid-body motion, 6:17226 (DOE/ER—03077-170)
TRANSPORTATION SECTOR
Economic Impact
Alaska OCS socioeconomic studies program. Technical report number 31. Northern Gulf of Alaska petroleum development scenarios transportation systems impacts. Final report, 6:16494 (PB—80-212467)
Energy Demand
Energy and transportation: issues for California, 6:16984
TRANSURANIUM COMPOUNDS
Radiation Monitoring
Soil monitoring instrumentation, 6:17403 (CONF-791234—)
Radioactive Waste Processing
Waste incineration, 6:16559 (CONF-791234—)
TREES
Energy Source Development
Chinese tallow tree as a cash and petroleum-substitute crop, 6:16659 (SERI/CP—622-1086)
Meetings
Tree crops for energy co-production on farms, 6:16658 (SERI/CP—622-1086)
Root Absorption
Increased cesium uptake by water tupelo under inundated conditions, 6:17443
TRI-GAS PROCESS
Process Development Units
Test and evaluate the tri-gas low-Btu coal-gasification process. Final report, October 21, 1977-October 31, 1980, 6:16346 (DOE/ET/10254—88)
TRIGGER CIRCUITS
Calibration
Technique for measurement of fast exponentially-decaying signals, 6:17229
Signals
Technique for measurement of fast exponentially-decaying signals, 6:17229
TRIIODOTHYRONINE
Side Effects
Thyroid hormone modulation of x-ray-induced in vitro neoplastic transformation, 6:17519
TRIPLET PARTICLES
See QUARKS
TRIPLETS
Orientation
Orientation of the primary donor in bacterial photosynthesis, 6:17498
TRITIUM
Breeding
Neutronic calculations for the conceptual design of an in-reactor solid breeder experiment, TRIO-01, 6:17839 (ORNL/TM—7758)
Monitoring
Static ^{3}He/^{4}He gas mass spectrometer for low level tritium concentration measurements, 6:17326 (DP-MS—80-105)
Radioecological Concentration
Annual environmental monitoring report: Calendar Year 1980, 6:17441 (MLM—2822)
TRITIUM COMPOUNDS
Radiopharmaceuticals
Melanin-binding radiopharmaceuticals, 6:17512 (BNL—28921)
Side Effects
Cell cycle kinetics in human lymphocyte cultures, 6:17518
TRITON REACTIONS
Stripping
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
Transfer Reactions
Production of 14 MeV neutrons with thermal neutrons on ^{6}LiD, 6:17692 (DOE/NDC—21/L(Vol.1))
Two-Nucleon Transfer Reactions
Two-neutron transfer in Pt nuclei and the structure of ^{200}Pt, 6:17729
TROMBE WALLS
Energy Analysis
Unified interzone and system coupling methodology for building energy analysis. Final report, 6:16961 (DOE/SF/10840—T1)
TUBES (CONDUITS)
See PIPES

TUMORS
See NEOPLASMS
TUNGSTEN
Atom Collisions
Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304)
Ion Collisions
Conceptual D^- source exploiting negative surface ionization of deuterons, 6:17584 (BNL—51304)
Positive and negative ionization by scattering from surfaces, 6:17569 (BNL—51304)
TURBOGENERATORS
Frequency Response Testing
Determination of synchronous-machine-stability study constants. Final report, 6:16787 (EPRI-EL—1424(Vol.2))
Stability
Determination of synchronous-machine-stability study constants. Final report, 6:16787 (EPRI-EL—1424(Vol.2))
TURBULENCE
Forecasting
Observed turbulence intensities in a desert boundary layer, 6:17345 (UCRL—84672)
TURBULENT FLOW
Deposits
Particulate deposition from turbulent parallel streams, 6:17624 (ANL/MHD—81-2)
TWO-PHASE FLOW
Transients
Measurement of transient two-phase flow velocity using statistical signal analysis of impedance probe signals, 6:17225 (CONF-810434—2(Draft))
TWO-STREAM INSTABILITY
Dispersion Relations
Nonlinear evolution of Buneman instability, 6:17803
Nonlinear Problems
Nonlinear evolution of Buneman instability, 6:17803
Plasma Heating
Nonlinear evolution of Buneman instability, 6:17803

U

UCLBL
See LAWRENCE BERKELEY LABORATORY
U-GAS PROCESS
Demonstration Plants
Memphis demonstration plant program, 6:16344 (CONF-800878—2)
ULTRACENTRIFUGE ENRICHMENT PLANTS
See CENTRIFUGE ENRICHMENT PLANTS
ULTRASONIC TESTING
Equipment
Single crystal metal wedges for surface acoustic wave propagation (Patent), 6:17232
UNDERGROUND DISPOSAL
Technology Assessment
Geothermal liquid waste disposal, 6:17457 (PNL—3700(Pt.5))
UNDERGROUND MINING
See also HYDRAULIC MINING
LONGWALL MINING
Accidents
For 110, the fine Avondale mine was a tomb (Avondale Mine, Pennsylvania, September 6, 1869), 6:16443
Orient mine tragedy, Part II: the conditions were ripe for an explosion, 6:16435
Orient mine tragedy: the last shift before Christmas, 6:16436
Environmental Effects
Effects of underground coal mining on ground water in the eastern United States. Final report, September 1976-September 1979, 6:17436 (PB—80-216757)
Environmental Impacts
Effects of underground coal mining on ground water in the eastern United States. Final report, September 1976-September 1979, 6:17436 (PB—80-216757)
Explosions
Orient mine tragedy: the last shift before Christmas, 6:16436
Geologic Structures
Geophysical methods for coal seam variability detection in front of mining face. Report No. 1, state of the art report, 6:16427 (DOE/TIC—11444)
Ground Subsidence
Design optimization in underground coal systems. Volume VII. Prediction of mining subsidence and related parameters over longwall mining operations. Final technical report, 6:16411 (FE—1231-25)
Information Needs
Geologic and engineering data acquisition for underground coal mine ground control. Contract research report, January 1976-November 1979, 6:16431 (PB—80-219272)
Roof Bolts
Inorganic cement for mine roof-bolt grouting, 6:16423 (BM-RI—8494)
Roofs
Method of investigations, estimation and classification of roofs in mines in the United States of America for the selection of suitable mechanized support for longwalls. Report No. 3, September 1, 1980-December 31, 1980, 6:16428 (DOE/TIC—11445)
Safety
Cooperation, commitment add up to worker safety at two mines, 6:16437
Mine safety analysis and training programs have impact in Kentucky, 6:16442
Safety Engineering
Mine safety analysis and training programs have impact in Kentucky, 6:16442
Strata Control
Engineering study of structural geologic features of the herrin (No. 6) coal and associated rock in Illinois. Volume 2. Detailed report. Final report, 1974-76, 6:16433 (PB—80-219462)
Geologic and engineering data acquisition for underground coal mine ground control. Contract research report, January 1976-November 1979, 6:16431 (PB—80-219272)
UNDERGROUND POWER TRANSMISSION
Electric Cables
Dielectric testing of polysil for inexpensive underground distribution and transmission, 6:16809 (EPRI-EL—1737)
UNDERGROUND STORAGE
Feasibility Studies
Underground hydrogen storage. Final report (Salt caverns, excavated caverns, aquifers and depleted fields), 6:16598 (BNL—51275)
UNIFIED GAUGE MODELS
From the standard model to composite quarks and leptons. Part I. Standard model, its present status and its open problems. Part II. Composite quarks and leptons, 6:17661 (SLAC—239)
Majorana Theory
Neutrino mixing in a grand unified theory, 6:17654 (DOE/ER/01545—289)
Spin
Comparing O(N) and SU(N) x SU(N) spin systems in 1 + 1 dimensions to SU(N) gauge theories in 3 + 1 dimensions, 6:17675 (DOE/ER/03130—T1)
UNILAC
Beam Monitors
Phase and bunch shape measurement in the UNILAC with capacitive probes, 6:17276 (LA-tr—80-42)
Phase probe measuring system in the UNILAC: probe dimensioning and signal evaluation, 6:17284 (LA-tr—80-43)
Performance
Phase probe measuring system in the UNILAC: probe dimensioning and signal evaluation, 6:17284 (LA-tr—80-43)
UNITED KINGDOM
Energy Demand
Input-output and energy demand models for the UK, 6:16891
Energy Models
Input-output and energy demand models for the UK, 6:16891
UNITED STATES OF AMERICA
See USA

UNIVERSE
Age Estimation
Neutron-capture cross sections for osmium isotopes and the age of the universe, 6:17721
UNLOADING (REACTOR)
See REACTOR FUELING
UNSTEADY FLOW
Mathematical Models
Unsteady transonic flow past airfoils in rigid-body motion, 6:17226 (DOE/ER—03077-170)
UPSILON RESONANCES
Photoproduction
Inelastic photoproduction of J/psi and Y by gluons, 6:17663
URANIUM
See also DEPLETED URANIUM
Electron-Atom Collisions
Ionization of uranium atoms by electron impact, 6:17603
Gas Tungsten-Arc Welding
Inert gas welding. 1964-August 1980 (citations from the NTIS Data Base). Report for 1964-August 1980, 6:17105 (PB—80-815210)
URANIUM 235
Isotope Separation
Generalized computer model of the transient behavior of multicomponent isotope-separation cascades, 6:16550 (MLM—2816(OP))
URANIUM 235 TARGET
Muon Reactions
Fission yields and lifetimes for muon induced fission in ^{235}U and ^{238}U, 6:17736
Neutron Reactions
Decay of ^{90}Rb/sup g/ and ^{90}Rb/sup m/, 6:17715
URANIUM 238 TARGET
Muon Reactions
Fission yields and lifetimes for muon induced fission in ^{235}U and ^{238}U, 6:17736
Proton Reactions
Fission reaction in high energy proton cascade (300 MeV), 6:17731 (DOE/NDC—21/L(Vol.1))
URANIUM ALLOYS
Quantitative Chemical Analysis
Direct determination of niobium in uranium-niobium alloys, 6:17161
URANIUM DEPOSITS
Aerial Prospecting
Aerial gamma ray and magnetic survey, Indianapolis quadrangle, Indiana and Illinois. Final report, 6:16547 (GJBX—97(81))
Aerial gamma ray and magentic survey, Vicennes quadrangle, Indiana, Illinois, and Kentucky. Final report, 6:16545 (GJBX—95(81))
Aerial gamma ray and magnetic survey, Cincinnati quadrangle, Indiana, Ohio, and Kentucky. Final report, 6:16546 (GJBX—96(81))
Aerial radiometric and magnetic survey: Sterling National Topographic Map, Colorado/Kansas/Nebraska. Final report, 6:16544 (GJBX—87(81))
Aerial radiometric and magnetic survey: Glasgow National Topographic Map, Montana. Final report, 6:16539 (GJBX—82(81))
Aerial radiometric and magnetic survey: MC Clusky National Topographic Map, North Dakota. Final report, 6:16541 (GJBX—84(81))
Aerial radiometric and magnetic survey: McIntosh National Topographic Map, North Dakota/South Dakota. Final report, 6:16543 (GJBX—86(81))
Aerial radiometric and magnetic survey: Bismarck National Topographic Map, North Dakota. Final report, 6:16542 (GJBX—85(81))
Aerial radiometric and magnetic survey: Williston National Topographic Map, North Dakota. Final report, 6:16540 (GJBX—83(81))
Geology
Geology and recognition criteria for uraniferous humate deposits, Grants Uranium Region, New Mexico. Final report, 6:16533 (GJBX—2(81))
Prospecting
Geology and recognition criteria for uranium deposits of the quartz-pebble conglomerate type. Final report, 6:16531 (GJBX—3(81))
Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16536 (GJBX—29(80)(Pt.7))
Hydrogeochemical and stream sediment detailed geochemical survey for Trans-Pecos, Texas, 6:16535 (GJBX—29-80(Pt.6))
Hydrogeochemical and stream sediment reconnaissance basic data for Dodge City NTMS Quadrangle, Kansas, 6:16538 (GJBX—77(81))
URANIUM DIOXIDE
Dissolution
Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)
Lattice Parameters
Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)
Leaching
Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)
Oxidation
Spent-fuel special-studies progress report: probable mechanisms for oxidation and dissolution of single-crystal UO_2 surfaces, 6:16555 (PNL—3566)
Proton Reactions
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
Proton Transport
Neutron production in thick targets of lead, thorium and uranium bombarded by 480 MeV protons, 6:17732 (DOE/NDC—21/L(Vol.1))
URANIUM HEXAFLUORIDE
Absorption
Temperature-controlled cell for laser-induced fluorescence and absorption studies, 6:17608
Decomposition
Collisional decomposition of UF_6^-, 6:17619
Fluorescence
Temperature-controlled cell for laser-induced fluorescence and absorption studies, 6:17608
Ion-Atom Collisions
Collisional decomposition of UF_6^-, 6:17619
URANIUM ISOTOPES
Laser Isotope Separation
Procedure and device for illuminating a three-dimensional area with a radiation beam, 6:16551 (ORNL-tr—4734)
URANIUM MILLS
See FEED MATERIALS PLANTS
URANIUM MINES
Environmental Effects
Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583
Health Hazards
Trace elements in soils of the south Texas uranium district: concentrations, origin, and environmental significance, 6:16583
Technology Assessment
Technology assessment, 6:17453 (PNL—3700(Pt.5))
URANIUM ORES
Research Programs
United States Department of Energy, Grand Junction Office, 6:16532 (GJO—112(81))
Resource Assessment
United States Department of Energy, Grand Junction Office, 6:16532 (GJO—112(81))
URANYL NITRATES
Criticality
Validation of the Monte Carlo criticality program KENO IV and the Hansen-Roach sixteen-energy-group-cross sections for high-assay uranium systems, 6:17214 (Y—2234)

URBAN AREAS
Domed Structures
Energy issues relevant to domed cities, Winooski, Vermont: a case study, 6:17043 (CONF-8003107—2)
Energy Management
Primary urban energy-management-planning methodology, 6:16884 (DOE/IR/05106—1)
UREA-FORMALDEHYDE FOAMS
Field Tests
Field investigation of the performance of residential retrofit insulation, 6:16965 (NBS-TN—1131)
Performance
Field investigation of the performance of residential retrofit insulation, 6:16965 (NBS-TN—1131)
URINE
Activation Analysis
Urinary metallothionein as a biological indicator of occupational cadmium exposure, 6:17525 (BNL—29064)
US BUREAU OF MINES
Research Programs
Measurement and control of respirable dust in mines, 6:16459 (NMAB—363)
US DOE
See also HANFORD RESERVATION
IDAHO NATIONAL ENGINEERING LABORATORY
LAWRENCE BERKELEY LABORATORY
MOUND LABORATORY
ORNL
ROCKY FLATS PLANT
SAVANNAH RIVER PLANT
United States Department of Energy, Grand Junction Office, 6:16532 (GJO—112(81))
Budgets
Statement submitted by Roger W.A. Legassie, Assistant Secretary (acting) for Fossil Energy, to the Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, US Senate March 23, 1981, 6:16920 (DOE/FE—0014)
Research Programs
Management and use of DOE-provided discretionary funds. Progress report, January-December 1980, 6:16901 (DOE/ER/10004—3)
Proceedings of the US Department of Energy's first technical contractors' conference on peat, 6:16390 (TR—80/031-001)
US NRC
Reporter at large: Three Mile Island. II. The paper trail, 6:16875
USA
See also ALABAMA
ALASKA
CALIFORNIA
CENTRAL REGION
COLORADO
GEORGIA
GREAT LAKES REGION
HAWAII
IDAHO
ILLINOIS
INDIANA
IOWA
KANSAS
KENTUCKY
MAINE
MASSACHUSETTS
MICHIGAN
MID-ATLANTIC REGION
MIDWEST REGION
MINNESOTA
MISSISSIPPI
MISSOURI
MONTANA
NEBRASKA
NEVADA
NEW MEXICO
NEW YORK
NORTH ATLANTIC REGION
NORTH CAROLINA
NORTH DAKOTA
OHIO
OKLAHOMA
OREGON
PACIFIC NORTHWEST REGION
PUERTO RICO
RHODE ISLAND
ROCKY MOUNTAIN REGION
SOUTH CAROLINA
SOUTH DAKOTA
SOUTHEAST REGION
SOUTHWEST REGION
TENNESSEE
TEXAS
UTAH
WASHINGTON
WASHINGTON DC
WESTERN REGION
WISCONSIN
Air Pollution
National emissions report, 1977: national emissions data system of the aerometric and emissions reporting system. Annual report, 6:17372 (PB—80-222532)
Coal Industry
Coal competition: prospects for the 1980s, 6:16457 (DOE/PE—0027(Add.))
Coal Reserves
Coal resource information. Volume 2, Part 3. Bibliography. Final report, 6:16420 (EPRI-EA—673(Vol.2Pt.3))
Coal resource information. Volume 2, Part 2. Annotation of selected sources. Final report, 6:16419 (EPRI-EA—673(Vol.2Pt.2))
District Heating
Potential for district heating: an historical overview, 6:17042 (CONF-810435—1)
Energy Demand
Commercial-energy-use model for the ten US Federal regions, 6:16911 (ORNL/CON—40)
Fuel Consumption
National emissions data system (NEDS) fuel use report (1977). Final report, 6:16924 (PB—80-212723)
Industrial Plants
US industrial energy consumption and conservation: past and future perspectives, 6:17029 (CONF-800483—(Vol.2))
Industry
Impact of regulation on industrial innovation, 6:16896
Regulations
Impact of regulation on industrial innovation, 6:16896
Renewable Energy Sources
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Wind Turbines
On-farm US irrigation pumping plants. Final report, 6:16778 (DOE/SEA—7315-20741/81/1)
Wind-Powered Pumps
On-farm US irrigation pumping plants. Final report, 6:16778 (DOE/SEA—7315-20741/81/1)
UTAH
Seismicity
Evaluation of hypocenter location techniques with applications to southern Utah: regional earthquake distributions and seismicity of geothermal areas, 6:16733 (DOE/ET/28392—32)
UTILITIES
See ELECTRIC UTILITIES
PUBLIC UTILITIES

V

VACUUM SYSTEMS
Testing
Leak checking in ISABELLE, 6:17262 (BNL—29148)
VALUES
Performance Testing
Test and evaluation of two Sigmon Corporation 6-inch Type K Ball Valves METC SOA Test Valve No. A-4 and METC SOA Test Valve No. B-4 for lockhopper service in coal conversion, 6:16369 (DOE/METC/SP—129)
VALVES
Panel discussion on throttle valves (Panel discussion), 6:16366 (DOE/MC/14522—1)
Design
Development of a packed-bed letdown valve for coal-liquefaction plants, 6:16382 (ORNL/MIT—321)

Proceedings of the 2nd symposium on valves for coal conversion and utilization, 6:16357 (DOE/MC/14522—1)
Selection and experience to date with block valves for the Exxon Coal-Liquefaction Pilot Plant, 6:16360 (DOE/MC/14522—1)
Valve requirements and experience in the H-coal liquefaction process, 6:16358 (DOE/MC/14522—1)

Erosion
Materials for erosive valve applications, 6:16365 (DOE/MC/14522—1)

Manufacturers
Slurry-letdown and isolation-valve performance at the Fort Lewis SRC Pilot Plant, 6:16361 (DOE/MC/14522—1)

Materials
Materials for erosive valve applications, 6:16365 (DOE/MC/14522—1)
Valve requirements and experience in the H-coal liquefaction process, 6:16358 (DOE/MC/14522—1)

Materials Testing
Proceedings of the 2nd symposium on valves for coal conversion and utilization, 6:16357 (DOE/MC/14522—1)

Performance
Selection and experience to date with block valves for the Exxon Coal-Liquefaction Pilot Plant, 6:16360 (DOE/MC/14522—1)
Slurry-letdown and isolation-valve performance at the Fort Lewis SRC Pilot Plant, 6:16361 (DOE/MC/14522—1)
Westinghouse fluidized-bed gasification process and valve requirements, 6:16363 (DOE/MC/14522—1)

Performance Testing
Critical valve specifications and METC valve-testing projects, 6:16367 (DOE/MC/14522—1)
Development of a packed-bed letdown valve for coal-liquefaction plants, 6:16382 (ORNL/MIT—321)
Kamyr P-D Series Full-Borne Ball Valve METC SOA Test Valve No. A-17 state-of-the-art lockhopper valve-testing and development project, 6:16446 (DOE/METC/SP—125)
Valve requirements and experience in the H-coal liquefaction process, 6:16358 (DOE/MC/14522—1)

Specifications
Critical valve specifications and METC valve-testing projects, 6:16367 (DOE/MC/14522—1)
Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)

Testing
Solids throttling valves for coal conversion and utilization development. Final report, 6:16356 (DOE/MC/12186—126)

VANADIUM

Physical Radiation Effects
Thermal testing of coated materials for limiters and protective plates in tokamak fusion test reactors, 6:17115

VANADIUM 46

High Spin States
Nuclear structure of high-spin states in ^{46}Ti and ^{46}V, 6:17705

VANADIUM ALLOYS

See also VANADIUM BASE ALLOYS

Electric Conductivity
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

Fabrication
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

Magnetic Properties
Future prospects for Nb_3Sn and V_3Ga multifilamentary conductors, 6:17079 (BNL—29256)

VANADIUM BASE ALLOYS

Chemical Composition
Study of diffusion of oxygen in dilute vanadium alloys using solid electrolytic cells, 6:17085 (DOE/ER/01198—1343)

Fatigue
Alloy development for irradiation performance. Quarterly progress report for period ending December 31, 1980, 6:17084 (DOE/ER—0045/5)

VANADIUM CARBIDES

Hot Pressing
Inelastic deformation in crystalline non-metallic materials. Progress report, 6:17120 (DOE/ER/04441—4)

VANADIUM COMPLEXES

Absorption Spectra
Polarized x-ray absorption and double refraction in vanadyl bisacetylacetonate, 6:17174

Dichroism
Polarized x-ray absorption and double refraction in vanadyl bisacetylacetonate, 6:17174

Refractivity
Polarized x-ray absorption and double refraction in vanadyl bisacetylacetonate, 6:17174

VANADIUM HYDRIDES

Ion Collisions
Emission of negative hydrogen ions from metal hydrides bombarded with cesium ions, 6:17577 (BNL—51304)

VANADIUM SILICIDES

Superconductivity
Far-infrared studies of superconducting V_3Si, Nb_3Ge, and Nb, 6:17749 (DOE/ER/10436—2)

VAPOR CONDENSATION

Nucleation
Condensation processes in coal-combustion products. Progress report, July 1, 1980-June 30, 1981, 6:16453 (DOE/ER/10456—2)

VAPOR INCINERATORS

See AFTERBURNERS

VEGETATION

See PLANTS

VEHICLES

See also AUTOMOBILES
BICYCLES
ELECTRIC-POWERED VEHICLES
FLYWHEEL-POWERED VEHICLES
MOTORCYCLES

Mirrors
Proposed rear view mirror characteristics and costs. Final report, January-April 1980, 6:16982 (PB—80-208218)

VELA PROJECT

See also GNOME EVENT

Decontamination
Site decontamination, 6:17408 (CONF-791234—)

VENEZUELA

Oil Fields
Estimation of oil recovery by in-situ combustion in the Jobo Field of Eastern Venezuela, 6:16485 (DOE/ET/12056—20)

VENTILATION SYSTEMS

Heat Exchangers
Test results and methods: residential air-to-air heat exchangers for maintaining indoor air quality and saving money, 6:16964 (LBL—12280)

VESSELS

See CONTAINERS

VESSELS (PRESSURE)

See PRESSURE VESSELS

VINOFLEX

See POLYVINYLS

VINYLBENZENE

See STYRENE

VIRGIL C SUMMER-1 REACTOR

See SUMMER-1 REACTOR

VISIBLE RADIATION

Variations
Light-shade adaptation of Stylophora pistillata, a hermatypic coral from the Gulf of Eilat, 6:17426

VISION

Radionuclide Kinetics
Metabolic mapping of the brain's response to visual stimulation: studies in humans, 6:17515

VOLCANIC ROCKS

See also BASALT

Age Estimation
Summary of potassium/argon age dating, 1980, 6:16762 (DOE/ID/12079—23)

VOLTAIC CELLS

See ELECTRIC BATTERIES

VORTICES (MAGNETIC)

See MAGNETIC FLUX

W

WALLS
See also TROMBE WALLS
Thermal Insulation
Field investigation of the performance of residential retrofit insulation, 6:16965 (NBS-TN—1131)
WASHINGTON
Water Resources
Water resources appraisal for hydroelectric licensing: Elwha River Basin, Washington. Appraisal report, 6:16619 (FERC—0072)
Wind Power
Network wind power over the Pacific Northwest. Appendix I. Wind power site survey report, 6:16765 (DOE/BP/01310—T1(App.1))
Network wind power over the Pacific Northwest. Wind statistics summaries for the wind power data stations, 6:16766 (DOE/BP/01310—T1(App.2))
WASHINGTON DC
Educational Facilities
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage I. Feasibility analysis. Final report. Volume 1, 6:17044 (DOE/CS/20068—4)
Georgetown University Integrated Community Energy System (GU-ICES). Phase III, Stage II. Preliminary design. Final report, 6:17045 (DOE/CS/20068—5)
WASTE BURIAL
See UNDERGROUND DISPOSAL
WASTE HEAT UTILIZATION
Rankine Cycle Power Systems
Cost-effective waste-heat Organic Rankine Cycle application and systems designs, 6:17013 (CONF-800483—(Vol.2))
Organic Rankine Cycle System: its application to extract energy from low-temperature waste heat, 6:17011 (CONF-800483—(Vol.2))
Power generation from waste heat using organic Rankine cycle systems, 6:17012 (CONF-800483—(Vol.2))
WASTE PROCESSING
See also ANAEROBIC DIGESTION
RADIOACTIVE WASTE PROCESSING
SLAGGING PYROLYSIS PROCESS
Technology Assessment
Environmental control technology for shale oil wastewaters, 6:17456 (PNL—3700(Pt.5))
WASTE PROCESSING PLANTS
Solar Process Heat
Applications of shallow solar ponds in wastewater treatment, 6:16720 (UCRL—15329)
WASTE SOLUTIONS
See LIQUID WASTES
WASTE TRANSPORTATION
Cost
Methods and costs for soil removal, 6:17414 (CONF-791234—)
WASTE WATER
Bioconversion
Production of biogas from waste waters of food-processing industries, 6:16990 (CONF-800483—(Vol.2))
Denitrification
Simulation of three-phase fluidized bioreactors for denitrification, 6:16564 (ORNL/MIT—324)
Energy Recovery
Production of biogas from waste waters of food-processing industries, 6:16990 (CONF-800483—(Vol.2))
Heat Recovery
Evaluation of industrial heat pumps for effective low-temperature heat utilization, 6:17015 (CONF-800483—(Vol.2))
Recycling
Water conservation in the home. Final report, 6:16980 (DOE/SF/01910—T2)
WASTE-FUELED POWER PLANTS
See REFUSE-FUELED POWER PLANTS
WASTE-ROCK INTERACTIONS
Research Programs
Laboratory studies of radionuclide distributions between selected groundwaters and geologic media. Progress report, October 1-December 31, 1980, 6:16578 (LA—8691-PR)
WATER
See also FEEDWATER
GROUND WATER
HOT WATER
SEAWATER
WASTE WATER
Resource Conservation
Water conservation in the home. Final report, 6:16980 (DOE/SF/01910—T2)
Sensible Heat Storage
COMMIX-SA-1: a three-dimensional thermohydrodynamic computer program for solar applications, 6:16724 (ANL—80-8)
WATER COOLED REACTORS
See also BWR TYPE REACTORS
HFIR REACTOR
PWR TYPE REACTORS
Reactor Accidents
Controlling hydrogen behavior in light water reactors, 6:16873 (LA-UR—81-681)
Reactor Safety
Fission-product source terms, 6:17380 (CONF-791234—)
WATER POLLUTION
Removal
Hudson River cleanup, 6:17427 (CONF-791234—)
WATER POLLUTION CONTROL
Technology Assessment
Decontamination of water bodies, 6:17434 (CONF-791234—)
WATER POLLUTION MONITORS
Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650)
WATER REMOVAL
Optimization
Peat pretreatment: high-pressure wet carbonization, 6:16608 (TR—80/031-001)
WATER RESERVOIRS
Annual Energy Storage
Longterm solar heat storage (abstract), 6:16725 (CONF-810509—1)
Sensible Heat Storage
Longterm solar heat storage (abstract), 6:16725 (CONF-810509—1)
WATER RESOURCES
Licenses
The administration of regulation: permit and licensing activities for water resource management in New York and New Jersey, 6:16917 (PB—80-223647)
Management
The administration of regulation: permit and licensing activities for water resource management in New York and New Jersey, 6:16917 (PB—80-223647)
Mapping
Alternative geographical display strategies for bivariate relationships, 6:17428 (CONF-810227—2)
Permits
The administration of regulation: permit and licensing activities for water resource management in New York and New Jersey, 6:16917 (PB—80-223647)
Planning
Planning status report: water resources appraisals for hydroelectric licensing. Savannah and Edisto River basins area, Georgia, South Carolina, and North Carolina, 6:16622 (FERC—0075)
Power Potential
Planning status report. Water resources appraisals for hydroelectric licensing: Colorado River Basin, Texas, 6:16626 (FERC—0079)
Water resources appraisal for hydroelectric licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia. Appraisal report, 6:16618 (FERC—0066)
Water resources appraisal for hydroelectric licensing: Elwha River Basin, Washington. Appraisal report, 6:16619 (FERC—0072)

Water resources appraisals for hydroelectric licensing: Santee River Basin, South Carolina and North Carolina. Planning status report, 6:16620 (FERC—0073)
Water resources appraisals for hydroelectric licensing: Tennessee River Basin, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, and Alabama. Planning status report, 6:16621 (FERC—0074)
Water resources appraisals for hydroelectric licensing: American River Basin, California. Planning status report, 6:16623 (FERC—0076)
Water resources appraisals for hydroelectric licensing: Cumberland River Basin, Kentucky and Tennessee. Planning status report, 6:16624 (FERC—0077)
Water resources appraisals for hydroelectric licensing: Tombigbee-Warrior River Basin, Alabama and Mississippi. Planning status report, 6:16625 (FERC—0078)

WATER SOURCE HEAT PUMPS
Performance
Combination central heat steam and heat pump installation. A comparison of a school with and without heat recovery, 6:16979

WATER TREATMENT PLANTS
Solar Process Heat
Applications of shallow solar ponds in wastewater treatment, 6:16720 (UCRL—15329)

WATER VAPOR
See also STEAM
Photolysis
Studies of metal: semiconductor interfaces in catalysis and energy conversion. Annual report, June 15, 1980-June 14, 1981, 6:16602 (COO—4946-3)

WAVEGUIDES
Cylindrical Configuration
Whispering-mode waveguide, 6:17755 (LA-UR—81-994)
Electric Impedance
Higher-order terms in a perturbation expansion for the impedance of a corrugated wave guide, 6:17268 (BNL—29213)

WAVES (SHOCK)
See SHOCK WAVES

WAZ 16
See NICKEL BASE ALLOYS

WEAK INTERACTIONS
See also LEPTONIC DECAY
Meetings
Proceedings of Summer Institute on Particle Physics: the weak interaction, 6:17632 (SLAC—239)
Unified Gauge Models
Electroweak interactions, 6:17656 (FERMILAB-Conf—80/86-THY)
Gauge theories of weak interactions, 6:17658 (SLAC—239)

WEAK NEUTRAL CURRENTS
Reviews
Theoretical and experimental review of the weak neutral current: a determination of its structure and limits on deviations from the minimal SU(2)/sub L/ x U(1) electroweak theory, 6:17645

WEATHER
Computerized Simulation
Geographical extrapolation of typical hourly weather data for energy calculation in buildings. Building science series (final), 6:16973 (PB—80-213424)

WELDED JOINTS
Mechanical Properties
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)
Mechanical Tests
Diagnostic test systems canister weld joint analysis, 6:17212 (UCID—18750)
Microstructure
Ferrous alloy metallurgy - liquid lithium corrosion and welding. Progress report, January 1-December 31, 1980, 6:17086 (DOE/ER/02313—T1)
Residual Stresses
X-ray diffraction study of residual stress in model weldments. Final report, 6:17109 (UCRL—15332)
Response Functions
Inelastic behavior of a dissimilar-metal-welded pipe transition joint: comparison of experimental measurements and analytical prediction, 6:16840 (GEFR-SP—148)
Stress Analysis
Diagnostic test systems canister weld joint analysis, 6:17212 (UCID—18750)

WELDS
See WELDED JOINTS

WELL COMPLETION
Program Management
Geothermal drilling and completion technology development program plan, 6:16758 (SAND—81-0380)

WELL DRILLING
Program Management
Geothermal drilling and completion technology development program plan, 6:16758 (SAND—81-0380)

WELLMAN-GALUSHA PROCESS
Air Pollution
Environmental assessment: source test and evaluation report - Wlllman-Galusha (Ft. Snelling) low-Btu gasification. Final report, September 1978-December 1979, 6:16413 (PB—80-219330)
Environmental Impacts
Environmental assessment: source test and evaluation report - Wlllman-Galusha (Ft. Snelling) low-Btu gasification. Final report, September 1978-December 1979, 6:16413 (PB—80-219330)

WELLS
See also GEOTHERMAL WELLS
INJECTION WELLS
NATURAL GAS WELLS
OIL WELLS
Maps
Well data file at the Savannah River Plant, 6:17543 (DP-MS—80-131)

WEST GERMANY
See FEDERAL REPUBLIC OF GERMANY

WESTERN REGION
See also CALIFORNIA
HAWAII
NEVADA
Appropriate Technology
Summary of projects: small-scale Appropriate-Energy Technology Grants Program, 6:16903 (DOE/SF/01963—T1)
Interconnected Power Systems
Power pooling in the Western Region, 6:16931 (FERC—0054)

WESTINGHOUSE GASIFICATION PROCESS
Process Development Units
Westinghouse fluidized-bed gasification process and valve requirements, 6:16363 (DOE/MC/14522—1)
Valves
Westinghouse fluidized-bed gasification process and valve requirements, 6:16363 (DOE/MC/14522—1)

WETTABILITY
Measuring Methods
Measurement of contact angles at room and reservoir conditions, 6:16468 (CONF-8004140—)
Wettability, the key to proper laboratory waterflooding experiments, 6:16467 (CONF-8004140—)

WHOLE-BODY IRRADIATION
Carcinogenesis
Radiation carcinogenesis. Comprehensive final report, 16 May 1979-31 December 1980, 6:17532 (DOE/EV/03017—43)

WILD ANIMALS
Environmental Effects
Effects of air emissions on wildlife resources. Air pollution and acid rain report No. 1, 6:17371 (PB—80-221708)

WIND
See also HURRICANES
STORMS
Boundary Layers
Marine boundary layer wind structure over the Bay of Bengal during MONEX79, 6:17342 (BNL—29260)
Daily Variations
Cape Canaveral sea breezes, 6:17348

WIND POWER
New renewable energy technologies and products (Special issue of Dept. of Commerce journal, Commercial News USA), 6:16939
Availability
Network wind power over the Pacific Northwest. Progress report, October 1978-September 1979, 6:16764 (DOE/BP/01310—T1)
Wind energy resource atlas. Volume 3. Great Lakes Region, 6:16768 (PNL—3195-WERA-3)
Wind energy resource atlas. Volume 10. Alaska region, 6:16769 (PNL—3195-WERA-10)
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)
Monitoring
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Handbook for the application of statistical techniques to wind characteristics at potential wind-energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16773 (DOE/ET/20283—3)
Network wind power over the Pacific Northwest. Appendix I. Wind power site survey report, 6:16765 (DOE/BP/01310—T1(App.1))
Network wind power over the Pacific Northwest. Wind statistics summaries for the wind power data stations, 6:16766 (DOE/BP/01310—T1(App.2))
Resource Assessment
Application of statistical techniques to wind characteristics at potential wind energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16772 (DOE/ET/20283—2)
Handbook for the application of statistical techniques to wind characteristics at potential wind-energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16773 (DOE/ET/20283—3)
Network wind power over the Pacific Northwest. Progress report, October 1978-September 1979, 6:16764 (DOE/BP/01310—T1)
Wind energy resource atlas. Volume 3. Great Lakes Region, 6:16768 (PNL—3195-WERA-3)
Wind energy resource atlas. Volume 10. Alaska region, 6:16769 (PNL—3195-WERA-10)
Wind energy resource atlas. Volume 2. The North Central Region, 6:16767 (PNL—3195-WERA-2)
Statistical Models
Application of statistical techniques to wind characteristics at potential wind energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16772 (DOE/ET/20283—2)
WIND POWER PLANTS
Economics
Community wind electrical power case study: Muir Beach. Final report, 6:16779 (DOE/SF/01963—T2)
Feasibility Studies
Community wind electrical power case study: Muir Beach. Final report, 6:16779 (DOE/SF/01963—T2)
Planning
Community wind electrical power case study: Muir Beach. Final report, 6:16779 (DOE/SF/01963—T2)
WIND TURBINES
Agriculture
Economic analysis of wind-powered crop drying. Final report, 6:16776 (DOE/SEA—1109-20401/81/2)
Data Compilation
On-farm US irrigation pumping plants. Final report, 6:16778 (DOE/SEA—7315-20741/81/1)
Economics
Economic analysis of wind-powered refrigeration cooling/water-heating systems in food processing. Final report, 6:16770 (DOE/SEA—1109-20401/81/1)
Guide to financial assistance for wind energy, 6:16771 (P—500-81-014)
Electric Generators
Induction machine (Patent), 6:16783
Feasibility Studies
Economic analysis of wind-powered refrigeration cooling/water-heating systems in food processing. Final report, 6:16770 (DOE/SEA—1109-20401/81/1)
Irrigation
Economics of wind energy for irrigation pumping, 6:16777 (DOE/SEA—7315-2074/81/2)
On-farm US irrigation pumping plants. Final report, 6:16778 (DOE/SEA—7315-20741/81/1)
Site Selection
Candidate wind-turbine-generator site annual data summary for January 1979 through December 1979, 6:16780 (PNL—3703)
Handbook for the application of statistical techniques to wind characteristics at potential wind-energy-conversion sites. Final report, October 1, 1978-September 30, 1979, 6:16773 (DOE/ET/20283—3)
Specifications
Using a wind electric system to generate power into a utility grid: a project in south central rural Minnesota, 6:16775 (DOE/R5/10134—1)
Subsidies
Guide to financial assistance for wind energy, 6:16771 (P—500-81-014)
WIND-POWERED PUMPS
Data Compilation
On-farm US irrigation pumping plants. Final report, 6:16778 (DOE/SEA—7315-20741/81/1)
Economics
Economics of wind energy for irrigation pumping, 6:16777 (DOE/SEA—7315-2074/81/2)
Farms
Windmill for irrigation pond. Final report, 6:16774 (DOE/R5/10124—T1)
Irrigation
Windmill for irrigation pond. Final report, 6:16774 (DOE/R5/10124—T1)
WISCONSIN
Air Quality
Air pollution studies near a coal-fired power plant. Wisconsin power plant impact study. Final report July 1975-July 1978, 6:17384 (PB—80-205792)
WOOD
Combustion
Method of regulating the amount of underfire air for combustion of wood fuels in spreader-stoker boilers (Patent) 6:17241
Gasification
Investigations on catalyzed steam gasification of biomass, 6:16654 (PNL—3695)
Liquefaction
Liquefaction of Douglas Fir wood slurries: titration of acids and anions in aqueous product and feed slurries, 6:16606 (LBL—12331)
Mechanical Properties
Composite wood utility poles. Final report, 6:16810 (EPRI-EL—1745)
Uses
Composite wood utility poles. Final report, 6:16810 (EPRI-EL—1745)
WOOD BURNING FURNACES
Air Pollution Control
Method of regulating the amount of underfire air for combustion of wood fuels in spreader-stoker boilers (Patent), 6:17241
Efficiency
Method of regulating the amount of underfire air for combustion of wood fuels in spreader-stoker boilers (Patent), 6:17241
Performance
Wood-coal fired small boiler case study, 6:16996 (CONF-800483—(Vol.2))
WOOD WASTES
Combustion
Method of regulating the amount of underfire air for combustion of wood fuels in spreader-stoker boilers (Patent), 6:17241
WOOD-FUEL POWER PLANTS
Energy from biomass and wastes: 1980 update, 6:16664
Economic Impact
Issues in the use of wood as an energy source in the northeastern US, 6:16638 (BNL—51196)

Feasibility Studies
Issues in the use of wood as an energy source in the northeastern US, 6:16638 (BNL—51196)
WORKERS
See PERSONNEL

X

X RADIATION
Radiation Protection
Nutritional and protective properties of thiocystine, 6:17520
Synergism
Radiation carcinogenesis. Comprehensive final report, 16 May 1979-31 December 1980, 6:17532 (DOE/EV/03017—43)
XENON
Energy Levels
Nuclear structure of ^{133}Te via beta decay and shell model calcuations in the doubly magin ^{132}Sn region (Petrovich-McManus-Madsen effective interaction), 6:17717
Ion-Atom Collisions
Collisional decomposition of UF_6^-, 6:17619
Measuring Methods
Cryogenic method for measuring nuclides and fission gases (Patent), 6:17323
XENON 136 REACTIONS
Deep Inelastic Heavy Ion Reactions
Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta, 6:17720
XI PARTICLES
Particle Production
Polarization in inclusive lambda production, 6:17628 (DOE/ER/01764—397)
X-RAY DIFFRACTION
Sample Preparation
Sample preparation of x-ray diffraction analysis and clay mineralogy of Devonian shale from the Appalachian basin, 6:16524 (DOE/METC—2287/112)
X-RAY FLUORESCENCE ANALYSIS
Uses
Applied research in laser spectroscopy and analytical techniques, 6:17329 (LBL—11650)
X-RAY RADIOGRAPHY (BIOMEDICAL)
See BIOMEDICAL RADIOGRAPHY
X-RAY SOURCES
See also COSMIC X-RAY SOURCES
Performance
Design and performance of the 1.5 MV injector for FXR, 6:17283 (UCRL—85060)
X-RAY SPECTRA
Data Processing
System for automatic x-ray-image analysis, measurement, and sorting of laser fusion targets, 6:17886 (UCRL—84549)
X-RAY SPECTROMETERS
Performance
Microanalysis of light elements with an ultrathin window x-ray spectrometer, 6:17327 (HEDL-SA—2122-FP)

Y

YTTRIUM 89 TARGET
Proton Reactions
Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr (Analysis by optical and collective DWBA), 6:17706
YTTRIUM FLUORIDES
Specific Heat
Thermodynamics of the lanthanide trifluorides. IV. The heat capacities of gadolinium trifluoride GdF_3, lutetium trifluoride LuF_3, and yttrium trifluoride YF_3 from 5 to 350°K, 6:17149
YTTRIUM OXIDES
Optical Properties
High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers, 6:17890

Z

ZEA MAYS
See MAIZE
ZINC
Biological Half-Life
Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb, 6:17439
Correlations
Serum copper and zinc levels in melanoma patients, 6:17493
Recycling
Proposed industrial recovered materials utilization targets for the metals and metal-products industry, 6:17033 (DOE/CS/40015—T2)
Twinning
Electron-dislocation interactions at low temperatures. Progress report, 6:17746 (DOE/ER/02305—T1)
Uptake
Cu and Zn kinetics in Myriophyllum heterophyllum Michx. and Potamogeton richardsonii (Ar. Benn.) Rydb, 6:17439
ZINC 65
Pairing Interactions
Method and an apparatus for non-invasively determining the quantity of an element in a body organ (Patent), 6:17322
ZINC PHOSPHIDES
Availability
Evaluation of critical materials in five additional advance design photovoltaic cells, 6:16655 (PNL—3710)
ZINC SULFIDES
Stacking Faults
Electronic structure of the rotation twin stacking fault in β-ZnS, 6:17126
ZINC-BROMINE BATTERIES
Cost
Development of zinc-bromine batteries for utility energy storage. Interim report, September 1978-August 1979, 6:16788 (EPRI-EM—1717)
Design
Development of zinc-bromine batteries for utility energy storage. Interim report, September 1978-August 1979, 6:16788 (EPRI-EM—1717)
Electrochemistry
Workshop on electrodes for flowing solution batteries. Summary report, 6:16881 (EPRI-WS—79-192)
Electrodes
Workshop on electrodes for flowing solution batteries. Summary report, 6:16881 (EPRI-WS—79-192)
Performance Testing
Development of zinc-bromine batteries for utility energy storage. Interim report, September 1978-August 1979, 6:16788 (EPRI-EM—1717)
ZIRCONIUM 90
Giant Resonance
Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr, 6:17706
ZIRCONIUM 90 TARGET
Proton Reactions
Elastic and inelastic scattering of 0.8 GeV protons by ^{89}Y and ^{90}Zr (Analysis by optical and collective DWBA), 6:17706
ZIRCONIUM FLUORIDES
Photoemission
UV photoemission from ZrF_4, 6:17154
ZIRCONIUM OXIDES
Optical Properties
High band gap oxide optical coatings for 0.25 and 1.06 μm fusion lasers, 6:17890
ZONES (RIFT)
See RIFT ZONES

ZOOPLANKTON
Entrainment
Approach to ecological assessment of power-plant-intake (316b) related issues: the Prairie Island case, 6:16855 (ORNL/TM—7412)
Food Chains
Flux of energy and essential elements through the continental shelf ecosystem. Progress report, May 31, 1980-May 31, 1981, 6:17429 (DOE/EV/00639—22)
ZT-40 DEVICES
Reviews
Toroidal reversed field-pinch experiments, 6:17856 (PPPL—1755)

CONTRACT NUMBER INDEX

Numbers assigned to DOE contracts under which reports announced in this publication were prepared are included in this index.

Contract No.	*Abstract No.*	*Report No.*
AB01-76CS31020	**Boeing Co., Seattle, WA (USA)**	
	6:16708	SOLAR/1008—80/50
AC01-76ET10722	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mining and Minerals Engineering**	
	6:16411	FE—1231-25
AC01-77ET10280	**Mitre Corp., McLean, VA (USA). METREK Div.**	
	6:16347	DOE/ET/10280—T1
AC01-78AD06212	**Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)**	
	6:17424	DOE/AD/06212—1
AC01-78ET10159	**System Development Corp., McLean, VA (USA)**	
	6:16390	TR—80/031-001
AC01-78ET12346	**Avco-Everett Research Lab., Inc., Everett, MA (USA)**	
	6:16941	DOE/ET/12346—T1
AC01-78ET13005	**Exxon Research and Engineering Co., Baytown, TX (USA)**	
	6:16350	DOE/ET/13005—T2
AC01-79ET11268	**Skelly and Loy, Harrisburg, PA (USA)**	
	6:16425	DOE/ET/11268—9
	6:16460	DOE/ET/11268—6
AC01-79ET14674	**Bell Aerospace Textron, Buffalo, NY (USA)**	
	6:16351	DOE/ET/14674—T1
AC01-79ET14801	**Air Products and Chemicals, Inc., Allentown, PA (USA)**	
	6:16352	DOE/ET/14801—6
	6:16353	DOE/ET/14801—9
AC01-79ET15529	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.**	
	6:16942	DOE/ET/15529—9
AC01-79ET23106	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
	6:16644	DOE/ET/23106—4
AC01-79ET25202	**Hittman Associates, Inc., Columbia, MD (USA)**	
	6:16672	DOE/ET/25202—1(Vol.1)
	6:16673	DOE/ET/25202—1(Vol.2)
AC01-79PE70044	**Hittman Associates, Inc., Columbia, MD (USA)**	
	6:16960	DOE/PE/70044—T2
AC01-79PE70078	**RAND Corp., Santa Monica, CA (USA)**	
	6:16977	RAND/R—2515-DOE
AC01-79PE70151	**TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.**	
	6:16648	DOE/PE/70151—T5
AC01-80EI10416	**TPI, Inc., Beltsville, MD (USA)**	
	6:16959	DOE/EI/10416—1
AC01-80ET14317	**Alaska Univ., Fairbanks (USA). Geophysical Inst.**	
	6:16487	DOE/ET/14317—T2(Vol.1)
AC01-80ET15611	**Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.**	
	6:16943	DOE/ET/15611—1
AC01-80IR10999	**Uniworld Group, Inc., Bethesda, MD (USA)**	
	6:16981	DOE/IR/10999—1
AC01-80RG10333	**First Harlem Management Corp., New York (USA)**	
	6:16922	DOE/RG/10333—T1
AC01-80RG10367	**Systems and Applied Sciences Corp., Riverdale, MD (USA)**	
	6:16914	DOE/RG/10367—T2
AC02-76CH0016	**Brookhaven National Lab., Upton, NY (USA)**	
	6:17681	DOE/NDC—21/L(Vol.1)
AC02-76CH00016	**Brookhaven National Lab., Upton, NY (USA)**	
	6:16592	BNL—51309
	6:16598	BNL—51275
	6:16631	BNL—51324
	6:16637	BNL—29160
	6:16638	BNL—51196
	6:16748	BNL—51287
	6:16854	BNL—51306
	6:16893	BNL—28956
	6:16926	BNL—51285
	6:16947	BNL—29133
	6:17064	BNL—51286
	6:17079	BNL—29256
	6:17137	BNL—29161
	6:17156	BNL—29258
	6:17224	BNL—29189
	6:17251	BNL—29201
	6:17252	BNL—29211
	6:17253	BNL—29212
	6:17254	BNL—29215
	6:17255	BNL—29295
	6:17261	BNL—29083
	6:17262	BNL—29148
	6:17263	BNL—29174
	6:17264	BNL—29176
	6:17265	BNL—29187
	6:17266	BNL—29208
	6:17267	BNL—29210
	6:17268	BNL—29213
	6:17269	BNL—29226
	6:17270	BNL—29242
	6:17271	BNL—29305
	6:17285	BNL—29091
	6:17286	BNL—29188
	6:17287	BNL—29194
	6:17288	BNL—29195
	6:17289	BNL—29196
	6:17290	BNL—29197
	6:17291	BNL—29209
	6:17292	BNL—29217
	6:17294	BNL—29232
	6:17295	BNL—29236
	6:17296	BNL—29241
	6:17297	BNL—29307
	6:17342	BNL—29260
	6:17349	BNL—29271
	6:17512	BNL—28921
	6:17525	BNL—29064
	6:17526	BNL—29066
	6:17527	BNL—29097
	6:17528	BNL—29259
	6:17542	BNL—51313
	6:17567	BNL—51304
	6:17627	BNL—29072
	6:17669	BNL—29074
	6:17827	BNL—29159
	6:17828	BNL—29190
AC02-76CH03000	**Fermi National Accelerator Lab., Batavia, IL (USA)**	
	6:17656	FERMILAB-Conf—80/86-THY
	6:17677	FERMILAB-CONF—80/79-THY
AC02-76ER00038	**Notre Dame Univ., IN (USA). Radiation Lab.**	
	6:17189	DOE/ER/00038—2210

Contract No.	Abstract No.	Report No.
AC02-76ER01198	**Illinois Univ., Urbana (USA)**	
	6:17085	DOE/ER/01198—1343
AC02-76ER01545	**Ohio State Univ., Columbus (USA). Dept. of Physics**	
	6:17654	DOE/ER/01545—289
	6:17670	DOE/ER/01545—301
AC02-76ER01764	**Minnesota Univ., Minneapolis (USA)**	
	6:17628	DOE/ER/01764—397
	6:17674	DOE/ER/01764—382
AC02-76ER02232	**California Inst. of Tech., Pasadena (USA)**	
	6:17629	DOE/ER/02232—97
AC02-76ER03072	**Princeton Univ., NJ (USA). Dept. of Physics**	
	6:17630	DOE/ER/03072—T3
AC02-76ER03077	**New York Univ., NY (USA). Courant Mathematics and Computing Lab.**	
	6:17226	DOE/ER—03077-170
AC02-76ER03130	**Ohio State Univ., Columbus (USA). Dept. of Physics**	
	6:17670	DOE/ER/01545—301
	6:17675	DOE/ER/03130—T1
	6:17676	DOE/ER/03130—T2
AC02-76ET20279	**Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.**	
	6:16668	DOE/ET/20279—120
	6:16669	DOE/ET/20279—122
	6:16670	DOE/ET/20279—126
	6:16671	DOE/ET/20279—129
AC02-76ET34202	**General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.**	
	6:16833	DOE/ET/34202—15
AC02-76EV03490	**Rochester Univ., NY (USA). School of Medicine and Dentistry**	
	6:16577	UR—3490-1978
	6:17346	UR—3490-1979
	6:17503	UR—3490-1977
	6:17513	UR—3490-1981
	6:17535	UR—3490-1883
AC02-77CH00178	**Solar Energy Research Inst., Golden, CO (USA)**	
	6:16628	SERI/TR—751-753
	6:16630	SERI/TR—633-1063
	6:16633	SERI/TP—731-1128
	6:16658	SERI/CP—622-1086
	6:16660	SERI/PR—8143-1-T3
	6:16661	SERI/TR—631-1004
	6:16662	SERI/TR—8272-1-T1
	6:16675	SERI/SP—433-487
	6:16681	SERI/TP—633-1148
	6:16687	SERI/TR—751-752
	6:16703	SERI/TP—631-1159
	6:16704	SERI/TP—632-1123
	6:16705	SERI/TR—721-822
	6:16706	SERI/TR—731-905
	6:16707	SERI/TR—751-751
	6:16726	SERI/TR—751-793
	6:16978	SERI/TP—721-1133
AC02-77CS20068	**Georgetown Univ., Washington, DC (USA)**	
	6:17044	DOE/CS/20068—4
	6:17045	DOE/CS/20068—5
AC02-77CS40041	**Hague International, South Portland, ME (USA)**	
	6:17034	DOE/CS/40041—1
AC02-77ET13046	**Institute of Gas Technology, Chicago, IL (USA)**	
	6:16344	CONF-800878—2
AC02-77ET20050	**Dynatech R/D Co., Cambridge, MA (USA)**	
	6:16605	DOE/ET/20050—T4
AC02-77ET34209	**General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.**	
	6:16829	GEAP—24310
AC02-77ET51010	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.**	
	6:17833	DOE/ET/51010—9
AC02-78ER04993	**Northwestern Univ., Evanston, IL (USA)**	
	6:17089	DOE/ER/04993—T1
AC02-78ET34216	**Philadelphia Electric Co., PA (USA)**	
	6:16827	DOE/ET/34216—T1
	6:16828	DOE/ET/34216—T2
AC02-79CS30062	**Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.**	
	6:16693	DOE/CS/30062—1
AC02-79ER10382	**General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.**	
	6:17121	DOE/ER/10382—2
AC02-79ER10392	**Illinois Univ., Urbana (USA). Dept. of Chemistry**	
	6:17186	DOE/ER/10392—4
AC02-79ER10404	**Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering**	
	6:17097	DOE/ET/10404—2
AC02-79ER10430	**Pennsylvania State Univ., University Park (USA)**	
	6:17080	CONF-800730—4
	6:17081	CONF-800730—5
	6:17082	CONF-800730—6
	6:17092	DOE/ER/10430—8
	6:17093	DOE/ER/10430—9
	6:17094	DOE/ER/10430—T1
	6:17122	DOE/ER/10430—7
AC02-79ER10439	**State Univ. of New York, Stony Brook (USA)**	
	6:17164	DOE/ER/10439—2
AC02-79ER10450	**Minnesota Univ., Minneapolis (USA)**	
	6:17096	DOE/ER/10450—1
AC02-79ER10453	**Rensselaer Polytechnic Inst., Troy, NY (USA)**	
	6:17123	DOE/ER/10453—2
AC02-79ER10454	**Pennsylvania State Univ., University Park (USA)**	
	6:17596	DOE/ER/10454—1
AC02-79ER10466	**Energy and Minerals Research Co., Exton, PA (USA)**	
	6:16445	DOE/ER/10466—1
AC02-79ER10496	**Iowa State Univ. of Science and Technology, Ames (USA)**	
	6:17597	DOE/ER/10496—2
AC02-79ER10514	**Kansas State Univ., Manhattan (USA). Dept. of Physics**	
	6:17598	DOE/ER/10514—12
AC02-79ET15208	**Foster-Miller Associates, Inc., Waltham, MA (USA)**	
	6:16784	DOE/ET/15208—T1(Vol.1)
	6:16785	DOE/ET/15208—T1(Vol.2)
AC02-79ET15422	**ENCOTH Corp., Princeton, NJ (USA)**	
	6:16945	DOE/ET/15422—6
AC02-79ET23003	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
	6:16641	DOE/ET/23003—3
AC02-79EV10268	**Harvard Medical School, Boston, MA (USA)**	
	6:17489	DOE/EV/10268—1
AC02-79EV10281	**Aspen Inst. for Humanistic Studies, CO (USA)**	
	6:17448	DOE/EV/10281—T3
AC02-80CS24310	**Ohio State Univ., Columbus (USA). Dept. of Civil Engineering**	
	6:16603	DOE/CS/24310—2
AC02-80ER10587	**Chicago Univ., IL (USA). Enrico Fermi Inst.**	
	6:17671	DOE/ER/10587—1
AC02-80ER10605	**Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.**	
	6:17177	DOE/ER/10605—4
AC02-80ER10612	**State Univ. of New York, Stony Brook (USA)**	
	6:17165	DOE/ER/10612—2
AC02-80ER10660	**State Univ. of New York, Stony Brook (USA)**	
	6:17187	DOE/ER/10660—1
AC02-80ER10677	**Kansas State Univ., Manhattan (USA)**	
	6:17201	DOE/ER/10677—1
AC02-80ER10740	**State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering**	
	6:17298	DOE/ER/10740—1

Contract No.	Abstract No.	Report No.
AC02-80ER10746	**Arizona Univ., Tucson (USA). Dept. of Chemistry**	
	6:17599	DOE/ER/10746—T1
AC02-80ER10774	**Iowa State Univ. of Science and Technology, Ames (USA)**	
	6:17561	DOE/ER/10774—1
AC02-80ET17089	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center**	
	6:16949	DOE/ET/17089—T1
AC02-81ER40014	**Colorado Univ., Boulder (USA). Nuclear Physics Lab.**	
	6:17256	DOE/ER/40014—1
AC03-76ET12047	**Long Beach City Dept. of Oil Properties, CA (USA)**	
	6:16482	DOE/ET/12047—52(Vol.1)
	6:16483	DOE/ET/12047—52(Vol.2)
	6:16484	DOE/ET/12047—52(Vol.3)
AC03-76ET12056	**Stanford Univ., CA (USA). Petroleum Research Inst.**	
	6:16485	DOE/ET/12056—20
AC03-76ET53057	**Science Applications, Inc., La Jolla, CA (USA). Lab. for Applied Plasma Studies**	
	6:17769	LAPS—71
	6:17799	SAI—254-81-102-LJ
AC03-76SF00012	**California Univ., Los Angeles (USA). Lab. of Biomedical and Environmental Sciences**	
	6:16634	UCLA—12-1281
	6:16635	UCLA—12/1282
	6:16636	UCLA—12/1283
AC03-76SF00515	**Stanford Linear Accelerator Center, CA (USA)**	
	6:17632	SLAC—239
	6:17745	SLAC-PUB—2662
	6:17899	SLAC—234
AC03-77CS31713	**Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.**	
	6:16694	DOE/CS/31713—T1
AC03-77CS34510	**United Technologies Research Center, East Hartford, CT (USA)**	
	6:16696	DOE/CS/34510—T1
AC03-77ET10296	**Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group**	
	6:16348	DOE/ET/10296—71
AC03-78CS32223	**Energetics Corp., Richardson, TX (USA)**	
	6:16695	DOE/CS/32223—T1
AC03-78CS40015	**Little (Arthur D.), Inc., Cambridge, MA (USA)**	
	6:17033	DOE/CS/40015—T2
AC03-78ER01885	**Rockwell International Corp., Thousand Oaks, CA (USA). Science Center**	
	6:17139	DOE/ER/01885—T1
AC03-78SF02034	**Gas-Cooled Reactor Associates, La Jolla, CA (USA)**	
	6:16834	DOE/SF/02034—T10
AC03-79ET21007	**Martin Marietta Corp., Denver, CO (USA)**	
	6:16677	MCR—78-1325
	6:16678	MCR—79-1311
AC03-79ET23036	**Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences**	
	6:16642	DOE/ET/23036—4
AC03-79ET23037	**Harvard Univ., Cambridge, MA (USA). Div. of Applied Sciences**	
	6:16643	DOE/ET/23037—1
AC03-79EV10024	**R and D Associates, Marina del Rey, CA (USA)**	
	6:16512	DOE/EV/10024—1
AC03-79SF10608	**McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)**	
	6:16701	MDC-G—8656ES
AC03-80SF10840	**CCB/CUMALI Associates, Oakland, CA (USA)**	
	6:16961	DOE/SF/10840—T1
AC04-76-DP00613	**Bendix Corp., Kansas City, MO (USA)**	
	6:17236	BDX—613-2551
AC04-76D00789	**Sandia National Labs., Albuquerque, NM (USA)**	
	6:16758	SAND—81-0380
AC04-76DP0079	**Sandia National Labs., Livermore, CA (USA)**	
	6:16680	SAND—80-8052
AC04-76DP00053	**Mound Facility, Miamisburg, OH (USA)**	
	6:16509	MLM-MU—81-53-0002
	6:16550	MLM—2816(OP)
	6:16589	MLM—2809
	6:17168	MLM—2815(OP)
	6:17339	MLM—2811
	6:17441	MLM—2822
AC04-76DP00487	**Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)**	
	6:17336	MHSMP—81-08
	6:17337	MHSMP—81-09
	6:17338	MHSMP—81-10
AC04-76DP00613	**Bendix Corp., Kansas City, MO (USA)**	
	6:17136	BDX—613-2553
	6:17204	BDX—613-2560
	6:17205	BDX—613-2566
	6:17235	BDX—613-2507
	6:17237	BDX—613-2598
	6:17891	BDX—613-2611
AC04-76DP00656	**General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.**	
	6:17234	GEPP-OP—563
AC04-76DP00789	**Sandia National Labs., Albuquerque, NM (USA)**	
	6:16386	SAND—80-2579
	6:16387	SAND—80-2664
	6:16388	SAND—80-2878
	6:16389	SAND—81-0968C
	6:16510	SAND—81-0371C
	6:16511	SAND—81-0387C
	6:16519	SAND—80-2219C
	6:16520	SAND—80-2307C
	6:16528	SAND—81-6001
	6:16556	SAND—80-2012
	6:16557	SAND—80-2124
	6:16590	SAND—81-7069
	6:16656	SAND—81-7002
	6:16657	SAND—81-7005
	6:16679	SAND—80-2378
	6:16716	SAND—80-1964/10
	6:16717	SAND—80-2504C
	6:16718	SAND—80-7076
	6:16719	SAND—81-8665
	6:16728	SAND—80-1959
	6:16743	SAND—81-0021
	6:16754	SAND—79-1592C
	6:16756	SAND—80-0410
	6:16757	SAND—80-7136
	6:16781	SAND—80-2646
	6:16782	SAND—80-2669C
	6:16874	SAND—81-0473
	6:16877	SAND—81-0067C
	6:16882	SAND—80-7191
	6:17077	SAND—81-0570C
	6:17108	SAND—80-2431C
	6:17124	SAND—80-2613C
	6:17125	SAND—81-0063C
	6:17131	SAND—81-0806C
	6:17143	SAND—80-2192
	6:17144	SAND—81-0475C
	6:17211	SAND—80-0135
	6:17341	SAND—80-1694
	6:17442	SAND—80-2573
	6:17445	SAND—81-0210
	6:17800	SAND—81-0116
	6:17881	SAND—80-2685C
	6:17898	SAND—81-0013
AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Energy Systems Group**	
	6:17107	RFP—3195
	6:17228	RFP—3198
AC04-76EV01013	**Inhalation Toxicology Research Inst., Albuquerque, NM (USA)**	
	6:17452	LMF—82
	6:17533	LMF—77
AC04-78AL10752	**New Mexico Health and Environment Dept., Santa Fe (USA)**	
	6:16582	DOE/AL/10752—10

Contract No.	Abstract No.	Report No.
AC04-78ET13116	**Combustion Electromagnetics, Inc., Lexington, MA (USA)**	
	6:17056	DOE/ET/13116—T13
AC04-79ET15397	**Science Applications, Inc., La Jolla, CA (USA)**	
	6:17057	DOE/ET/15397—T3
AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis**	
	6:16915	ORAU/IEA—25(1980)
AC05-78ET13513	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
	6:17098	DOE/ET/13513—T8
	6:17099	DOE/ET/13513—T9
AC06-76RL01830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
	6:16555	PNL—3566
	6:16560	DOE/NWTS—33(2)
	6:16562	ONWI—138
	6:16563	ONWI—222
	6:16565	PNL—2990
	6:16566	PNL—3090
	6:16567	PNL-SA—9054
	6:16573	PNL-TR—410
	6:16580	PNL—3414
	6:16591	PNL—1845-49
	6:16654	PNL—3695
	6:16655	PNL—3710
	6:16767	PNL—3195-WERA-2
	6:16768	PNL—3195-WERA-3
	6:16769	PNL—3195-WERA-10
	6:16780	PNL—3703
	6:16976	PNL—3605
	6:17305	PNL—3536
	6:17524	PNL—3409
	6:17552	ONWI—104
	6:17840	PNL—3685
AC06-77RL01030	**Rockwell International Corp., Richland, WA (USA). Energy Systems Group**	
	6:16568	RHO-BWI—80-100-4Q
	6:16569	RHO-BWI-CD—38(Rev.3)
	6:16570	RHO-LD—153
	6:17545	RHO-BWI-C—87
AC06-77RL90283	**Stearns-Roger Services, Inc., Denver, CO (USA)**	
	6:16563	ONWI—222
AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
	6:16576	EGG-WM—5393
	6:16860	CONF-801053—11
	6:16861	CONF-810235—1
	6:16862	CONF-810307—3
	6:16870	EGG/GEND—003
	6:17836	EGG-PHYS—5392
AC07-78ET28392	**Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics**	
	6:16727	DOE/ET/28392—31
	6:16731	DOE/ET/28392—23
	6:16732	DOE/ET/28392—25
	6:16733	DOE/ET/28392—32
AC07-79ET27002	**Utah Univ., Salt Lake City (USA). Dept. of Geology and Geophysics**	
	6:16729	DOE/ET/27002—1
	6:16730	DOE/ET/27002—2
AC07-79ID12079	**Utah Univ., Salt Lake City (USA). Earth Science Lab.**	
	6:16734	DOE/ID/12079—21
	6:16735	DOE/ID/12079—24
	6:16736	DOE/ID/12079—29
	6:16762	DOE/ID/12079—23
	6:17547	DOE/ID/12079—25
	6:17548	DOE/ID/12079—26
AC08-76NV00597	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.**	
	6:16554	DOE/NV/00597—6
AC08-78DP40070	**TRW Systems and Energy, Redondo Beach, CA (USA)**	
	6:17220	DOE/DP/40070—1
AC08-79DP40083	**McDonnell Douglas Astronautics Co., St. Louis, MO (USA)**	
	6:16585	DOE/DP/40083—1
AC08-79DP40109	**TRW Defense and Space Systems Group, Redondo Beach, CA (USA)**	
	6:17830	DOE/DP/40109—2
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	6:17326	DP-MS—80-105
	6:17383	DP—1583
	6:17440	DP—1592
	6:17543	DP-MS—80-131
AC12-76SN00052	**Knolls Atomic Power Lab., Schenectady, NY (USA)**	
	6:17227	KAPL—4139
AC13-76GJ01664	**South Dakota School of Mines and Technology, Rapid City (USA)**	
	6:16531	GJBX—3(81)
	6:16532	GJO—112(81)
	6:16533	GJBX—2(81)
	6:16534	GJBX—9(81)
	6:16535	GJBX—29-80(Pt.6)
	6:16536	GJBX—29(80)(Pt.7)
	6:16537	GJBX—38(81)
	6:16539	GJBX—82(81)
	6:16540	GJBX—83(81)
	6:16541	GJBX—84(81)
	6:16542	GJBX—85(81)
	6:16543	GJBX—86(81)
	6:16544	GJBX—87(81)
	6:16545	GJBX—95(81)
	6:16546	GJBX—96(81)
	6:16547	GJBX—97(81)
AC14-76FF02170	**Hanford Engineering Development Lab., Richland, WA (USA)**	
	6:16841	HEDL-SA—2116
	6:16842	HEDL-SA—2200
	6:16843	HEDL-TME—81-4
	6:16857	HEDL-SA—1985
	6:16872	HEDL-SA—2121-FP
	6:17100	HEDL-SA—1936
	6:17206	HEDL-SA—2191
	6:17327	HEDL-SA—2122-FP
AC18-79FC10059	**Virginia Corp. of Richmond (USA)**	
	6:16793	DOE/GFETC/10059—2
AC19-79BC10069	**Illinois Inst. of Tech., Chicago (USA)**	
	6:16480	DOE/BC/10069—10
AC20-78LC10049	**Texas Transportation Inst., College Station (USA)**	
	6:16529	DOE/LC/10049—T1
AC21-76ET12138	**West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography**	
	6:16463	DOE/ET/12138—T2
	6:16464	DOE/ET/12138—T3
AC21-78ET10254	**Bituminous Coal Research, Inc., Monroeville, PA (USA)**	
	6:16346	DOE/ET/10254—88
AC21-78ET11330	**Institute of Gas Technology, Chicago, IL (USA)**	
	6:16375	FE—2806-16
	6:17239	CONF-801104—13
AC21-78MC08089	**TRW Energy Systems Group, Morgantown, WV (USA)**	
	6:16516	DOE/MC/08089—107
AC21-79ET14815	**Bituminous Coal Research, Inc., Monroeville, PA (USA)**	
	6:16354	DOE/ET/14815—20
AC21-79MC10689	**New Mexico Inst. of Mining and Technology, Socorro (USA)**	
	6:16488	DOE/MC/10689—5
AC21-79MC11577	**SRI International, Menlo Park, CA (USA)**	
	6:16518	DOE/MC/11577—T9
AC21-79MC12186	**Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center**	
	6:16356	DOE/MC/12186—126
AC21-80ET15492	**Air Pollution Technology, Inc., San Diego, CA (USA)**	
	6:16403	DOE/ET/15492—T12
AC22-80PC30013	**Pennsylvania State Univ., University Park (USA). Coal Research Section**	
	6:16396	DOE/PC/30013—3

Contract No.	Abstract No.	Report No.
AC22-80PC30088	**Chicago Univ., IL (USA)**	
	6:16371	DOE/PC/30088—4
AC22-80PC30291	**Avco-Everett Research Lab., Inc., Everett, MA (USA)**	
	6:16372	DOE/PC/30291—1
AC32-79AL10563	**Republic Geothermal, Inc., Santa Fe Springs, CA (USA)**	
	6:16749	DOE/AL/10563—T8(Vol.1)
	6:16750	DOE/AL/10563—T8(Vol.2)
	6:16751	DOE/AL/10563—T8(Vol.3)
	6:16752	DOE/AL/10563—T8(Vol.4)
AC80-78BP01310	**Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science**	
	6:16764	DOE/BP/01310—T1
	6:16765	DOE/BP/01310—T1(App.1)
	6:16766	DOE/BP/01310—T1(App.2)
AI01-76ET10136	**Geological Survey, Reston, VA (USA)**	
	6:16524	DOE/METC—2287/112
AI01-76ET20319	**Tetra Tech, Inc., Arlington, VA (USA)**	
	6:16770	DOE/SEA—1109-20401/81/1
	6:16776	DOE/SEA—1109-20401/81/2
	6:16777	DOE/SEA—7315-2074/81/2
	6:16778	DOE/SEA—7315-20741/81/1
AI01-77CS51044	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	6:17069	DOE/NASA/51044—17
AI01-77ET20342	**Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.**	
	6:16684	JHU/APL-SR—80-1A
	6:16685	JHU/APL-SR—80-1B
AI01-78CS54209	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	6:17068	DOE/CS/54209—T1
AI08-79DP40095	**National Bureau of Standards, Washington, DC (USA)**	
	6:17118	DOE/DP/40095—T1
AM01-79PE70106	**Harvard Univ., Cambridge, MA (USA). Energy and Environmental Policy Center**	
	6:16894	DOE/PE/70106—T5
AM02-76CH03073	**Princeton Univ., NJ (USA). Plasma Physics Lab.**	
	6:17774	PPPL—1729
	6:17796	PPPL—1766
	6:17797	PPPL—1768
	6:17798	PPPL—1776
	6:17841	PPPL—1755
	6:17880	PPPL-Q—37
AM21-78MC08216	**Science Applications, Inc., Morgantown, WV (USA)**	
	6:16517	DOE/MC/08216—140
AM21-80MC14522	**TRW Energy Systems Group, Morgantown, WV (USA)**	
	6:16357	DOE/MC/14522—1
	6:16446	DOE/METC/SP—125
AS02-76R02383	**Illinois Univ., Urbana (USA). Dept. of Computer Science**	
	6:17896	DOE/ER/02383—T2
AS02-76ER02305	**Connecticut Univ., Storrs (USA)**	
	6:17746	DOE/ER/02305—T1
AS02-76ER02313	**Colorado School of Mines, Golden (USA)**	
	6:17086	DOE/ER/02313—T1
AS02-76ER02383	**Illinois Univ., Urbana (USA). Dept. of Computer Science**	
	6:17894	DOE/ER/02383—0078
	6:17895	DOE/ER/02383—T1
AS02-76ER02462	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering**	
	6:17087	DOE/ER/02462—T1
AS02-76ER02755	**Purdue Univ., Lafayette, IN (USA). Lab. of Renewable Resources Engineering**	
	6:17465	DOE/ER/02755—5
AS02-76ER02899	**Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering**	
	6:17140	DOE/ER/02899—T2
AS02-76ER02923	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
	6:17119	DOE/ER/02923—4
AS02-76ER02960	**Connecticut Univ., Storrs (USA). Dept. of Metallurgy**	
	6:17185	DOE/ER/02960—T1
AS02-76ER13246	**Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Chemistry**	
	6:17724	DOE/ER/13246—20
AS02-76ET53048	**Wesleyan Univ., Middletown, CT (USA)**	
	6:17760	DOE/ET/53048—3
AS02-76EV02401	**Wayne State Univ., Detroit, MI (USA). Kresge Eye Inst.**	
	6:17502	DOE/EV/02401—T1
AS02-76EV03017	**New England Deaconess Hospital, Boston, MA (USA). Cancer Research Inst.**	
	6:17469	DOE/EV/03017—T1
	6:17532	DOE/EV/03017—43
AS02-76EV04047	**Rhode Island Univ., Kingston (USA). University Energy Center**	
	6:16499	DOE/EV/24047—03
AS02-76EV04115	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	6:17192	DOE/EV/04115—4
AS02-77ER04441	**Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering**	
	6:17120	DOE/ER/04441—4
AS02-77ER04475	**Illinois Univ., Urbana (USA)**	
	6:16639	DOE/ER/04475—2
AS02-77ET20030	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nutrition and Food Science**	
	6:16614	DOE/ET/20030—1
AS02-77ET29102	**Purdue Univ., Lafayette, IN (USA)**	
	6:16805	DOE/ET/29102—1
AS02-77EV04361	**Clarkson Coll. of Tech., Potsdam, NY (USA)**	
	6:17600	DOE/EV/04361—T2
AS02-77EV04502	**Pittsburgh Univ., PA (USA)**	
	6:16402	DOE/ET/04502—7
AS02-77EV04548	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering**	
	6:16498	DOE/EV/04548—1
AS02-78CS40153	**Pennsylvania Univ., Philadelphia (USA)**	
	6:17083	DOE/CS/40153—T1
AS02-78ER04799	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
	6:17088	DOE/ER/04799—2
AS02-78ER04900	**Yale Univ., New Haven, CT (USA)**	
	6:16604	DOE/ER/04900—1
AS02-78ER04927	**Arizona Univ., Tucson (USA)**	
	6:16640	DOE/ER/04927—T4
	6:17466	DOE/ER/04927—T1
	6:17467	DOE/ER/04927—T2
	6:17468	DOE/ER/04927—T3
AS02-78ER04938	**Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy**	
	6:17754	DOE/ER/04938—T1
AS02-78ER04946	**Northwestern Univ., Evanston, IL (USA)**	
	6:16602	COO—4946-3
AS02-78ER04971	**New York Univ., NY (USA). Dept. of Physics**	
	6:17594	DOE/ER/04971—3
AS02-78ER05002	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering**	
	6:17090	DOE/ER/05002—15
AS02-78ER05002—16	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	6:17747	DOE/ER/05002—16
AS02-78ER10004	**Illinois Univ., Urbana (USA). Office of Energy Research**	
	6:16901	DOE/ER/10004—3
AS02-78ER10107	**Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.**	
	6:17832	DOE/ER/10107—1

Contract No.	Abstract No.	Report No.
AS02-78ET29185	**Wisconsin Univ., Madison (USA)**	
	6:16806	DOE/ET/29185—18
	6:16807	DOE/ET/29185—19
AS02-78ET37218	**Massachusetts Inst. of Tech., Cambridge (USA)**	
	6:16866	DOE/ET/37218—1
	6:16867	DOE/ET/37218—2
	6:16868	DOE/ET/37218—3
	6:16869	DOE/ET/37218—4
AS02-78EV04733	**Brookhaven National Lab., Upton, NY (USA)**	
	6:17528	BNL—29259
AS02-79ER10375	**Purdue Univ., Lafayette, IN (USA)**	
	6:17748	DOE/ER/10375—T1
AS02-79ER10402	**Saint Bonaventure Univ., NY (USA)**	
	6:17655	DOE/ER/10402—T1
AS02-79ER10421	**Utah Univ., Salt Lake City (USA). Dept. of Materials Science and Engineering**	
	6:17130	DOE/ER/10421—T1
AS02-79ER10423	**Minnesota Univ., Minneapolis (USA)**	
	6:17560	DOE/ER/10423—T2
AS02-79ER10428	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering**	
	6:17117	DOE/ER/10428—2
AS02-79ER10429	**Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering**	
	6:17091	DOE/ER/10429—T2
AS02-79ER10433	**Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science**	
	6:17095	DOE/ER/10433—2
AS02-79ER10440	**Washington Univ., St. Louis, MO (USA). Dept. of Physics**	
	6:17750	DOE/ER/10440—2
AS02-79ER10456	**Johns Hopkins Univ., Baltimore, MD (USA)**	
	6:16453	DOE/ER/10456—2
AS03-77ET20413	**Cornell Univ., Ithaca, NY (USA)**	
	6:16711	DOE/ET/20413—T1
AS05-76CS40092	**Clemson Univ., SC (USA). Dept. of Chemical Engineering**	
	6:17035	DOE/CS/40092—T1
AS05-76ER03602	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry**	
	6:17200	ORO—3602-21
AS05-76ER04936	**Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy**	
	6:17722	DOE/ER/04936—6
AS05-76ER05246	**Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station**	
	6:16599	DOE/ER/05246—T1
AS05-76ET10463	**Kentucky Univ., Lexington (USA). Dept. of Chemical Engineering**	
	6:16349	DOE/ET/10463—T1(Vol.2)
AS05-76EV02412	**Emory Univ., Atlanta, GA (USA). Dept. of Biology**	
	6:17531	DOE/EV/02412—105
AS05-76EV03018	**Louisiana State Univ., Baton Rouge (USA). Choppin Chemical Labs.**	
	6:17343	CONF-8005149—1
AS05-76EV04703	**Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy**	
	6:17601	DOE/EV/04703—T1
AS05-78ER06036	**Texas A and M Univ., College Station (USA). Dept. of Chemistry**	
	6:17595	DOE/ER/06036—1
AS05-78OR13402	**Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.**	
	6:16370	DOE/OR/13405—T1
AS05-79ER10436	**Emory Univ., Atlanta, GA (USA)**	
	6:17749	DOE/ER/10436—2
AS05-80ER10418	**Georgia Univ., Athens (USA). Dept. of Physics**	
	6:17699	DOE/ER/10418—T1
AS06-76ET20283	**Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering**	
	6:16772	DOE/ET/20283—2
	6:16773	DOE/ET/20283—3
AS08-78DP40013	**Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics**	
	6:17138	DOE/DP/40013—1
AS09-76EV00639	**Georgia Univ., Athens (USA). Inst. of Ecology**	
	6:17429	DOE/EV/00639—22
AS09-76EV00889	**Skidaway Inst. of Oceanography, Savannah, GA (USA)**	
	6:17555	DOE/EV/00889—7(Vol.1)
	6:17556	DOE/EV/00889—7(Vol.2)
	6:17557	DOE/EV/00889—7(Vol.3)
AS09-79ER10434	**South Carolina Univ., Columbia (USA). Dept. of Physics and Astronomy**	
	6:17723	DOE/ER/10434—2
AT03-76ER70107	**California Univ., Riverside (USA)**	
	6:17642	UCR—34P107-263
AT03-76ER70218	**California Univ., Los Angeles (USA). Dept. of Chemistry**	
	6:17178	DOE/ER/70218—T2
AT03-76ET12075	**University of Southern California, Los Angeles (USA). Dept. of Petroleum Engineering**	
	6:16486	DOE/ET/12075—2
AT03-76ET35300	**General Atomic Co., San Diego, CA (USA)**	
	6:16836	GA-A—16283
AT03-76ET35301	**General Atomic Co., San Diego, CA (USA)**	
	6:16835	GA-A—16217
AT03-76ET51011	**General Atomic Co., San Diego, CA (USA)**	
	6:17761	GA-A—16194
	6:17837	GA-A—16098
AT03-76SF70030	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
	6:16840	GEFR-SP—148
AT03-76SF71023	**General Atomic Co., San Diego, CA (USA)**	
	6:16838	GA-A—15406(add.)
AT03-76SF71031	**General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.**	
	6:16839	GEFR-SP—146
AT06-79ER10405	**Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik**	
	6:17701	DOE/ER/10405—2
FC01-75IR08141	**Texas Industrial Commission, Austin (USA)**	
	6:16988	CONF-800483—(Vol.2)
FC49-80R910031	**Hirai (W.A.) and Associates, Inc., Hilo, HI (USA)**	
	6:16617	DOE/R9/10031—T1
FG01-77ET12543	**Montana Coll. of Mineral Science and Technology, Butte (USA)**	
	6:16426	DOE/ET/12543—1
FG01-78IR06355	**American Electronic Labs., Inc., Montgomeryville, PA (USA)**	
	6:16404	DOE/IR/06355—T1
FG02-78IR05106	**Public Technology, Inc., Washington, DC (USA)**	
	6:16884	DOE/IR/05106—1
FG02-79R510106	**Southern Illinois Univ., Carbondale (USA). Dept. of Physics and Astronomy**	
	6:16725	CONF-810509—1
FG02-79R510124	**Klaus (Thomas), Cooks, MI (USA)**	
	6:16774	DOE/R5/10124—T1
FG02-79R510134	**Natural Resources Corp., Brooklyn Park, MN (USA)**	
	6:16775	DOE/R5/10134—1
FG02-79R510151	**EVNA Corp., Athens, OH (USA)**	
	6:17036	DOE/R5/10151—1
FG02-80ER10125	**Michigan Univ., Ann Arbor (USA)**	
	6:16902	DOE/ER/10125—1
FG02-80R510213	**Resource Alternatives, Mossville, IL (USA)**	
	6:16697	DOE/R5/10213—1
FG02-80R510215	**Gerber (Sherman), Northbrook, IL (USA)**	
	6:16698	DOE/R5/10215—1
FG02-80R510235	**Hokanson (Brad), Minneapolis, MN (USA)**	
	6:16709	DOE/R5/10235—1
FG02-80R510246	**Sherwood Forest Products, Inc., Waverly, OH (USA)**	
	6:16699	DOE/R5/10246—1

Contract No.	Abstract No.	Report No.
FG03-78SF01910	**Hawaii Community Design Center, Honolulu (USA)**	
	6:16980	DOE/SF/01910—T2
FG03-78SF01963	**Freebairn-Smith (Rod), Muir Beach, CA (USA)**	
	6:16779	DOE/SF/01963—T2
	6:16885	DOE/SF/01963—T3
	6:16903	DOE/SF/01963—T1
FG03-78SF01973	**Arizona State Univ., Tempe (USA). Coll. of Architecture**	
	6:16700	DOE/SF/01973—T1
FG22-80PC30214	**Lehigh Univ., Bethlehem, PA (USA)**	
	6:17240	DOE/PC/30214—T1
NAS-7-100-954331	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
	6:16645	DOE/JPL/954331—81/13
NAS-7-100-954373	**Crystal Systems, Inc., Salem, MA (USA)**	
	6:16646	DOE/JPL/954373—80/18
NAS-7-100-954852	**Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering**	
	6:16647	DOE/JPL/954852—7
NAS-7-100-955298	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	6:16674	DOE/JPL/955298—T1
W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
	6:16452	ANL/ECT-TM—3
	6:16629	ANL-K—80-63
	6:16667	CONF-800567—5
	6:16688	ANL/EES-TM—128
	6:16689	ANL-K—80-44
	6:16690	ANL-K—80-53
	6:15691	ANL-K—80-59
	6:16692	ANL-K—80-68
	6:16724	ANL—80-8
	6:16784	DOE/ET/15208—T1(Vol.1)
	6:16785	DOE/ET/15208—T1(Vol.2)
	6:16826	CONF-800592—8
	6:16837	ANL—80-97
	6:16856	CONF-800592—9
	6:16899	ANL/EES-TM—127
	6:16940	ANL/MHD—80-5
	6:16946	ANL—80-67
	6:16956	ANL/EES-TM—124
	6:16985	ANL/CNSV—11
	6:16986	ANL/CNSV—15
	6:16987	ANL/CNSV-TM—55
	6:17063	ANL/OEPM—80-5
	6:17065	CONF-800523—4
	6:17163	ANL—81-7
	6:17351	EPRI-CS—1683-SY
	6:17386	ANL/EES-TM—103
	6:17433	ANL/ES—112
	6:17447	ANL/AA—24
	6:17451	CONF-800567—6
	6:17500	CONF-8004147—1
	6:17624	ANL/MHD—81-2
	6:17652	ANL-HEP-CP—80-60
	6:17653	ANL-HEP-CP—80-64
	6:17826	ANL/FPP/TM—141
	6:17829	CONF-801210—24
W-7405-ENG-26	**Oak Ridge National Lab., TN (USA)**	
	6:16345	CONF-810402—9
	6:16382	ORNL/MIT—321
	6:16383	ORNL/Sub—7685/1
	6:16384	ORNL/TM—7581
	6:16395	CONF-810308—10
	6:16399	Y/DK—263
	6:16444	CONF-810203—7
	6:16465	CONF-810308—11
	6:16538	GJBX—77(81)
	6:16549	K/CSD/TM—36
	6:16551	ORNL-tr—4734
	6:16553	CONF-810337—1
	6:16558	ORNL-tr—4740
	6:16564	ORNL/MIT—324
	6:16575	ORNL-tr—4739
	6:16579	ORNL—5601
	6:16584	K/OA—4955
	6:16593	CONF-810345—1
	6:16601	ORNL/TM—7561
	6:16804	CONF-810433—1
	6:16814	CONF-810411—
	6:16845	ORNL—5690
	6:16846	ORNL—5756
	6:16855	ORNL/TM—7412
	6:16858	ORNL/TM—7754
	6:16864	CONF-810434—1
	6:16865	CONF-810434—3
	6:16880	ORNL/CSD/TM—145
	6:16890	ORNL—5754
	6:16911	ORNL/CON—40
	6:16962	DOE/TIC—11436
	6:16966	ORNL/Sub—7715/2
	6:16967	ORNL/TM—7629
	6:17041	CONF-810343—1
	6:17042	CONF-810435—1
	6:17043	CONF-8003107—2
	6:17084	DOE/ER—0045/5
	6:17158	ORNL/TM—7608
	6:17169	ORNL—5747
	6:17199	ORNL/TM—7605
	6:17214	Y—2234
	6:17215	Y—2235
	6:17225	CONF-810434—2(Draft)
	6:17272	CONF-810314—82
	6:17325	CONF-810437—1
	6:17350	CONF-810346—1
	6:17395	CONF-800160—1
	6:17401	CONF-791234—
	6:17425	ORNL/TM—7644
	6:17428	CONF-810227—2
	6:17431	ORNL—5611
	6:17432	ORNL/TM—7654
	6:17435	ORNL—5602
	6:17530	CONF-810428—(Absts.)
	6:17544	ORNL/TM—7289
	6:17553	ORNL/TM—7695
	6:17686	ORNL/TM—7786
	6:17734	ORNL/TM—7661
	6:17735	ORNL/TM—7732
	6:17744	ORNL/TM—7415
	6:17765	LA—8729-MS
	6:17767	LA-UR—81-682
	6:17770	ORNL/Sub—7676/1
	6:17771	ORNL/TM—7132
	6:17772	ORNL/TM—7616
	6:17773	ORNL/TM—7675
	6:17838	ORNL/TM—7691
	6:17839	ORNL/TM—7758
	6:17892	CONF-810431—1
	6:17893	CONF-810436—1
W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	6:16378	LA-UR—81-764
	6:16454	DOE/TIC—11441
	6:16507	LA-UR—81-735
	6:16508	LA-UR—81-736
	6:16548	GJBX—99(81)
	6:16561	LA-UR—81-830
	6:16578	LA—8691-PR
	6:16712	LA-UR—81-1023
	6:16737	LA—8676-T
	6:16738	LA—8710-HDR
	6:16812	LA—8606-PR
	6:16844	LA—8742-PR
	6:16859	LA-UR—81-703
	6:16873	LA-UR—81-681
	6:17102	LA-UR—81-747
	6:17142	LA-UR—81-1021
	6:17157	LA-UR—81-898
	6:17208	LA—8669-MS
	6:17209	LA-UR—81-831
	6:17249	LA-UR—81-818
	6:17257	LA-UR—81-730
	6:17258	LA-UR—81-737
	6:17259	LA-UR—81-784
	6:17277	LA-UR—81-731
	6:17278	LA-UR—81-746
	6:17279	LA-UR—81-772
	6:17280	LA-UR—81-783
	6:17281	LA-UR—81-805
	6:17284	LA-tr—80-43
	6:17299	LA-UR—81-781
	6:17328	LA-UR—81-679
	6:17353	LA-UR—80-3052
	6:17354	LA-UR—81-729
	6:17511	LA-UR—81-748
	6:17529	CONF-810350—1
	6:17565	LA-UR—81-870
	6:17755	LA-UR—81-994
	6:17763	LA—8161-M

Contract No.	*Abstract No.*	*Report No.*
	6:17764	LA—8425-MS
	6:17766	LA—8738-MS
	6:17768	LA-UR—81-896
	6:17897	LA-UR—81-1024
W-7405-ENG-48	**Standard Oil Co. of California, San Francisco (USA)**	
	6:16379	LBL—12152
	6:16380	LBL—12308
	6:16515	UCID—18585(Suppl.1)
	6:16526	UCID—18282(Rev.1)
	6:16527	UCRL—15323
	6:16571	UCID—18845
	6:16572	UCRL—85032
	6:16606	LBL—12331
	6:16682	UCID—18977
	6:16686	LBL—12328
	6:16720	UCRL—15329
	6:16739	LBL—12012
	6:16745	UCRL—13897(Rev.1)
	6:16753	LBL—12220
	6:16763	LBL—12356
	6:16878	CONF-791258—(Summ.)
	6:16879	UCRL—15324
	6:16888	LBL—11972
	6:16906	UCID—18890
	6:16955	UCID—18991
	6:16964	LBL—12280
	6:17071	UCRL—84445
	6:17072	UCRL—85390
	6:17073	UCRL—85425
	6:17078	UCRL—84843
	6:17103	LBL—10639
	6:17109	UCRL—15332
	6:17116	UCRL—15318
	6:17132	UCRL—53105
	6:17133	UCRL—84039
	6:17212	UCID—18750
	6:17213	UCRL—53116
	6:17221	UCRL—84260
	6:17238	UCRL—50025-80-3
	6:17260	LBL—10757
	6:17282	UCRL—85037
	6:17283	UCRL—85060
	6:17345	UCRL—84672
	6:17355	LBL—11650
	6:17356	LBL—12199
	6:17378	UCID—18997
	6:17422	UCRL—53066
	6:17430	LBL—12431
	6:17491	LBL—11858
	6:17554	UCRL—83789(Rev.1)
	6:17625	UCRL—85677-VUGRAPH
	6:17631	LBL—12275
	6:17743	LBL—11652
	6:17801	UCID—18988
	6:17802	UCRL—85666
	6:17882	UCID—18798
	6:17883	UCID—18916
	6:17884	UCID—18948
	6:17885	UCID—18989
	6:17886	UCRL—84549
	6:17887	UCRL—85073
	6:17900	UCID—18981
	6:17901	UCRL—85679
	6:17902	UCRL—85680(VUGRAPH)
W-7405-ENG-82	**Ames Lab., IA (USA)**	
	6:16397	IS-T—948
	6:17166	IS-T—911
	6:17657	IS-T—929
W-7405-ENG-92-096	**Battelle Columbus Labs., OH (USA)**	
	6:17834	DOE/TIC—11435(Vol.1)
	6:17835	DOE/TIC—11435(Vol.2)
W-7504-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
	6:17276	LA-tr—80-42

REPORT NUMBER INDEX

The numbers assigned to all reports cited in the publication appear in the first column of the index. The citation numbers are included in the second column. Cross reference information and/or availability are included as appropriate. Abbreviations used in the availability column are elaborated at the end of the index.

Report No.	*Abstract No.*	*Availability*
ANL-		
80-8	6:16724	NTIS, PC A03/MF A01
80-67	6:16946	NTIS, PC A03/MF A01
80-97	6:16837	NTIS, PC A08
81-7	6:17163	NTIS, PC A03/MF A01
ANL/AA-		
24	6:17447	NTIS, PC A03/MF A01
ANL/CNSV-		
11	6:16985	NTIS, PC A06/MF A01
15	6:16986	NTIS, PC A03/MF A01
ANL/CNSV-TM-		
55	6:16987	NTIS, PC A03/MF A01
ANL-CT-		
81-11	6:16829	*See* GEAP-24310
ANL/ECT-TM-		
3	6:16452	NTIS, PC A04/MF A01
ANL/EES-TM-		
103	6:17386	NTIS, PC A07/MF A01
124	6:16956	NTIS, PC A02/MF A01
127	6:16899	NTIS, PC A03/MF A01
128	6:16688	NTIS, PC A03/MF A01
ANL/ES-		
112	6:17433	NTIS, PC A04/MF A01
ANL/FPP/TM-		
141	6:17826	NTIS, PC A03/MF A01
ANL-HEP-CP-		
80-60	6:17652	NTIS, PC A02/MF A01
80-64	6:17653	NTIS, PC A02/MF A01
ANL-K-		
80-44	6:16689	NTIS, PC A05/MF A01
80-53	6:16690	NTIS, PC A04/MF A01
80-59	6:16691	NTIS, PC A02/MF A01
80-63	6:16629	NTIS, PC A05/MF A01
80-68	6:16692	NTIS, PC A05/MF A01
ANL/MHD-		
80-5	6:16940	NTIS, PC A05/MF A01
81-2	6:17624	NTIS, PC A03/MF A01
ANL/OEPM-		
80-5	6:17063	NTIS, PC A05/MF A01
BDX-		
613-2507	6:17235	NTIS, PC A02/MF A01
613-2551	6:17236	NTIS, PC A02/MF A01
613-2553	6:17136	NTIS, PC A02/MF A01
613-2560	6:17204	NTIS, PC A03/MF A01
613-2566	6:17205	NTIS, PC A02/MF A01
613-2598	6:17237	NTIS, PC A02/MF A01
613-2611	6:17891	NTIS, PC A05/MF A01
BM-RI-		
8494	6:16423	Bureau of Mines, Washington, DC
8498	6:17423	Bureau of Mines, Washington, DC
BM-TPR-		
111	6:16424	Bureau of Mines, Washington, DC
BNL-		
28921	6:17512	NTIS, PC A02/MF A01
28956	6:16893	NTIS, PC A03/MF A01
29064	6:17525	NTIS, PC A02/MF A01
29066	6:17526	NTIS, PC A02/MF A01
29072	6:17627	NTIS, PC A02/MF A01
29074	6:17669	NTIS, PC A02/MF A01
29083	6:17261	NTIS, PC A02/MF A01
29091	6:17285	NTIS, PC A02/MF A01
29097	6:17527	NTIS, PC A02/MF A01
29133	6:16947	NTIS, PC A03/MF A01
29148	6:17262	NTIS, PC A02/MF A01
29159	6:17827	NTIS, PC A02/MF A01
29160	6:16637	NTIS, PC A02/MF A01
29161	6:17137	NTIS, PC A02/MF A01
29174	6:17263	NTIS, PC A03/MF A01
29176	6:17264	NTIS, PC A02/MF A01
29187	6:17265	NTIS, PC A02/MF A01
29188	6:17286	NTIS, PC A02/MF A01
29189	6:17224	NTIS, PC A02/MF A01
29190	6:17828	NTIS, PC A02/MF A01
29194	6:17287	NTIS, PC A02/MF A01
29195	6:17288	NTIS, PC A02/MF A01
29196	6:17289	NTIS, PC A02/MF A01
29197	6:17290	NTIS, PC A02/MF A01
29201	6:17251	NTIS, PC A02/MF A01
29208	6:17266	NTIS, PC A02/MF A01
29209	6:17291	NTIS, PC A02/MF A01
29210	6:17267	NTIS, PC A02/MF A01
29211	6:17252	NTIS, PC A02/MF A01
29212	6:17253	NTIS, PC A02/MF A01
29213	6:17268	NTIS, PC A02/MF A01
29215	6:17254	NTIS, PC A02/MF A01
29217	6:17292	NTIS, PC A02/MF A01
29218	6:17293	NTIS, PC A02/MF A01
29226	6:17269	NTIS, PC A02/MF A01
29232	6:17294	NTIS, PC A02/MF A01
29236	6:17295	NTIS, PC A02/MF A01
29241	6:17296	NTIS, PC A02/MF A01
29242	6:17270	NTIS, PC A02/MF A01
29256	6:17079	NTIS, PC A02/MF A01
29258	6:17156	NTIS, PC A03/MF A01
29259	6:17528	NTIS, PC A02/MF A01
29260	6:17342	NTIS, PC A02/MF A01
29271	6:17349	NTIS, PC A03/MF A01
29295	6:17255	NTIS, PC A02/MF A01
29305	6:17271	NTIS, PC A02/MF A01
29307	6:17297	NTIS, PC A02/MF A01
51196	6:16638	NTIS, PC A07/MF A01
51275	6:16598	NTIS, PC A12/MF A01
51285	6:16926	NTIS, PC A04/MF A01
51286	6:17064	NTIS, PC A05/MF A01
51287	6:16748	NTIS, PC A05/MF A01
51304	6:17567	NTIS, PC A09/MF A01
51304	6:17568	NTIS, PC A09/MF A01
51304	6:17569	NTIS, PC A09/MF A01
51304	6:17570	NTIS, PC A09/MF A01
51304	6:17571	NTIS, PC A09/MF A01
51304	6:17572	NTIS, PC A09/MF A01
51304	6:17573	NTIS, PC A09/MF A01
51304	6:17574	NTIS, PC A09/MF A01
51304	6:17575	NTIS, PC A09/MF A01
51304	6:17576	NTIS, PC A09/MF A01
51304	6:17577	NTIS, PC A09/MF A01
51304	6:17578	NTIS, PC A09/MF A01
51304	6:17579	NTIS, PC A09/MF A01
51304	6:17580	NTIS, PC A09/MF A01
51304	6:17581	NTIS, PC A09/MF A01
51304	6:17582	NTIS, PC A09/MF A01
51304	6:17583	NTIS, PC A09/MF A01
51304	6:17584	NTIS, PC A09/MF A01
51304	6:17585	NTIS, PC A09/MF A01
51304	6:17586	NTIS, PC A09/MF A01
51304	6:17587	NTIS, PC A09/MF A01
51304	6:17588	NTIS, PC A09/MF A01
51304	6:17589	NTIS, PC A09/MF A01
51304	6:17590	NTIS, PC A09/MF A01
51304	6:17591	NTIS, PC A09/MF A01
51304	6:17592	NTIS, PC A09/MF A01
51304	6:17593	NTIS, PC A09/MF A01
51306	6:16854	NTIS, PC A02/MF A01
51309	6:16592	NTIS, PC A05/MF A01
51313	6:17542	NTIS, PC A05/MF A01
51324	6:16631	NTIS, PC A06/MF A01
BNL-NCS-		
51245(Vol.1)	6:17273	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17274	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17681	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17682	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17683	*See* DOE/NDC-21/L(Vol.1)

Report No.	*Abstract No.*	*Availability*
51245(Vol.1)	6:17684	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17690	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17691	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17692	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17693	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17694	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17695	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17696	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17700	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17702	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17703	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17707	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17712	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17718	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17725	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17731	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17732	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.1)	6:17737	*See* DOE/NDC-21/L(Vol.1)
51245(Vol.2)	6:17275	*See* DOE/NDC-21/L(Vol.2)
51245(Vol.2)	6:17685	*See* DOE/NDC-21/L(Vol.2)
51245(Vol.2)	6:17704	*See* DOE/NDC-21/L(Vol.2)
51245(Vol.2)	6:17713	*See* DOE/NDC-21/L(Vol.2)
51245(Vol.2)	6:17726	*See* DOE/NDC-21/L(Vol.2)
CONF-771102-	(70. annual AICHE meeting, New York, NY, USA, 13-17 Nov 1977)	
	6:16586	75: No. 191, 219-227(1979)
	6:16588	75: No. 191, 193-195(1979)
CONF-7711147-	(Meeting on pollution in the atmosphere, London, UK, 3-4 Nov 1977)	
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CONF-7805220-	(Workshop on the Impact of Federal Regulations on Industrial Innovations, New York, NY, USA, 2-3 May 1978)	
	6:16896	National Academy of Engineering, Office of the Foreign Secretary, Washington, DC
CONF-7811182-	(European offshore steels research seminar, Cambridge, UK, 27-29 Nov 1978)	
	6:17242	Abington, England; Welding Inst. (1980).
CONF-790140-	(International workshop on gross properties of nuclei and nuclear excitations VII, Hirschegg, Kleinwalsertal, Austria, 15-20 Jan 1979)	
(Pt.A)	6:17697	*See* INKA-Conf-79-001-000
(Pt.A)	6:17719	*See* INKA-Conf-79-001-000
CONF-790615-	(3. US national congress on pressure vessels and piping, San Francisco, CA, USA, 25-29 Jun 1979)	
29	6:16839	*See* GEFR-SP-146
CONF-7910187-	(Open workshop on solar technologies, Washington, DC, USA, 23-24 Oct 1979)	
(Suppl.)	6:16632	NTIS, PC A07/MF A01
CONF-7910208-	(International conference on energy conservation-utilization of urban waste heat, Tokyo, Japan, 1-5 Oct 1979)	
(Absts)	6:16897	Tokyo, JP; Tokyo Electric Power Co., Inc. (1979).
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10(Rev.1)	6:17554	*See* UCRL-83789(Rev.1)
CONF-7911140-	(Workshop on electrodes for flowing solution batteries, Tampa, FL, USA, 5-7 Nov 1979)	
(Summ.)	6:16881	*See* EPRI-WS-79-192
CONF-791225-	(Symposium on compact toruses and energetic particle injection, Princeton, NJ, USA, 11-14 Dec 1979)	
	6:17775	*See* PPPL-1755
	6:17776	*See* PPPL-1755
	6:17777	*See* PPPL-1755
	6:17778	*See* PPPL-1755
	6:17779	*See* PPPL-1755
	6:17780	*See* PPPL-1755
	6:17781	*See* PPPL-1755
	6:17782	*See* PPPL-1755
	6:17783	*See* PPPL-1755
	6:17784	*See* PPPL-1755
	6:17785	*See* PPPL-1755
	6:17786	*See* PPPL-1755
	6:17787	*See* PPPL-1755
	6:17788	*See* PPPL-1755
	6:17789	*See* PPPL-1755
	6:17790	*See* PPPL-1755
	6:17791	*See* PPPL-1755
	6:17792	*See* PPPL-1755
	6:17793	*See* PPPL-1755
	6:17794	*See* PPPL-1755
	6:17795	*See* PPPL-1755
	6:17841	*See* PPPL-1755
	6:17842	*See* PPPL-1755
	6:17843	*See* PPPL-1755
	6:17844	*See* PPPL-1755
	6:17845	*See* PPPL-1755
	6:17846	*See* PPPL-1755
	6:17847	*See* PPPL-1755
	6:17848	*See* PPPL-1755
	6:17849	*See* PPPL-1755
	6:17850	*See* PPPL-1755
	6:17851	*See* PPPL-1755
	6:17852	*See* PPPL-1755
	6:17853	*See* PPPL-1755
	6:17854	*See* PPPL-1755
	6:17855	*See* PPPL-1755
	6:17856	*See* PPPL-1755
	6:17857	*See* PPPL-1755
	6:17858	*See* PPPL-1755
	6:17859	*See* PPPL-1755
	6:17860	*See* PPPL-1755
	6:17861	*See* PPPL-1755
	6:17862	*See* PPPL-1755
	6:17863	*See* PPPL-1755
	6:17864	*See* PPPL-1755
	6:17865	*See* PPPL-1755
	6:17866	*See* PPPL-1755
	6:17867	*See* PPPL-1755
	6:17868	*See* PPPL-1755
	6:17869	*See* PPPL-1755
	6:17870	*See* PPPL-1755
	6:17871	*See* PPPL-1755
	6:17872	*See* PPPL-1755
	6:17873	*See* PPPL-1755
	6:17874	*See* PPPL-1755
	6:17875	*See* PPPL-1755
	6:17876	*See* PPPL-1755
	6:17877	*See* PPPL-1755
	6:17878	*See* PPPL-1755
	6:17879	*See* PPPL-1755
CONF-791234-	(Environmental decontamination workshop, Oak Ridge, TN, USA, 4-5 Dec 1979)	
	6:16559	NTIS, PC A12/MF A01
	6:16581	NTIS, PC A12/MF A01
	6:17380	NTIS, PC A12/MF A01
	6:17381	NTIS, PC A12/MF A01
	6:17382	NTIS, PC A12/MF A01
	6:17401	NTIS, PC A12/MF A01
	6:17402	NTIS, PC A12/MF A01
	6:17403	NTIS, PC A12/MF A01
	6:17404	NTIS, PC A12/MF A01
	6:17405	NTIS, PC A12/MF A01
	6:17406	NTIS, PC A12/MF A01
	6:17407	NTIS, PC A12/MF A01
	6:17408	NTIS, PC A12/MF A01
	6:17409	NTIS, PC A12/MF A01
	6:17410	NTIS, PC A12/MF A01
	6:17411	NTIS, PC A12/MF A01
	6:17412	NTIS, PC A12/MF A01
	6:17413	NTIS, PC A12/MF A01
	6:17414	NTIS, PC A12/MF A01
	6:17415	NTIS, PC A12/MF A01
	6:17416	NTIS, PC A12/MF A01
	6:17417	NTIS, PC A12/MF A01
	6:17418	NTIS, PC A12/MF A01
	6:17419	NTIS, PC A12/MF A01
	6:17420	NTIS, PC A12/MF A01
	6:17427	NTIS, PC A12/MF A01
	6:17434	NTIS, PC A12/MF A01
	6:17450	NTIS, PC A12/MF A01
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(Summ.)	6:16878	NTIS, PC A11/MF A01
CONF-800121-	(Workshop on gross properties of nuclei and nuclear excitations, Hirschegg, Austria, 14-19 Jan 1980)	
	6:17708	*See* INIS-mf-6088
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CONF-800160-	(Workshop on differential equations in populations: epidemics and ecology, Clairmont, CA, USA, 10-11 Jan 1980)	
1	6:17395	NTIS, PC A03/MF A01
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11	6:16754	*See* SAND-79-1592C

Report No.	Abstract No.	Availability
CONF-800336-		(Radiopharmaceuticals: structure activity relationships symposium, Hartford, CT, USA, 21-23 Mar 1980)
3	6:17512	*See* BNL-28921
CONF-8003107-		(International dome symposium, Winooski, VT, USA, 27 Mar 1980)
2	6:17043	NTIS, PC A02/MF A01
CONF-8003133-		(Conference and workshop on problems of coal freezing, Cincinnati, OH, USA, 31 Mar-1 Apr 1980)
	6:16448	*See* EPRI-WS-80-119
CONF-8003134-		(1. technical contractors' conference on peat, Rockville, MD, USA, 11-12 Mar 1980)
	6:16390	*See* TR-80/031-001
	6:16417	*See* TR-80/031-001
	6:16421	*See* TR-80/031-001
	6:16607	*See* TR-80/031-001
	6:16608	*See* TR-80/031-001
	6:16609	*See* TR-80/031-001
	6:16610	*See* TR-80/031-001
	6:16611	*See* TR-80/031-001
	6:16612	*See* TR-80/031-001
	6:16613	*See* TR-80/031-001
	6:17449	*See* TR-80/031-001
	6:17906	*See* TR-80/031-001
CONF-800420-		(2. international ocean disposal symposium, Woods Hole, MA, USA, 15-18 Apr 1980)
6	6:17442	*See* SAND-80-2573
CONF-800432-		(2. international conference on multiphoton processes, Budapest, Hungary, 14-18 Apr 1980)
2	6:17221	*See* UCRL-84260
CONF-800483-		(2. annual conference on industrial energy conservation technology and exhibition, Houston, TX, USA, 13-16 Apr 1980)
(Vol.2)	6:16490	NTIS, PC A19/MF A01
(Vol.2)	6:16666	NTIS, PC A19/MF A01
(Vol.2)	6:16676	NTIS, PC A19/MF A01
(Vol.2)	6:16900	NTIS, PC A19/MF A01
(Vol.2)	6:16957	NTIS, PC A19/MF A01
(Vol.2)	6:16958	NTIS, PC A19/MF A01
(Vol.2)	6:16988	NTIS, PC A19/MF A01
(Vol.2)	6:16989	NTIS, PC A19/MF A01
(Vol.2)	6:16990	NTIS, PC A19/MF A01
(Vol.2)	6:16991	NTIS, PC A19/MF A01
(Vol.2)	6:16992	NTIS, PC A19/MF A01
(Vol.2)	6:16993	NTIS, PC A19/MF A01
(Vol.2)	6:16994	NTIS, PC A19/MF A01
(Vol.2)	6:16995	NTIS, PC A19/MF A01
(Vol.2)	6:16996	NTIS, PC A19/MF A01
(Vol.2)	6:16997	NTIS, PC A19/MF A01
(Vol.2)	6:16998	NTIS, PC A19/MF A01
(Vol.2)	6:16999	NTIS, PC A19/MF A01
(Vol.2)	6:17000	NTIS, PC A19/MF A01
(Vol.2)	6:17001	NTIS, PC A19/MF A01
(Vol.2)	6:17002	NTIS, PC A19/MF A01
(Vol.2)	6:17003	NTIS, PC A19/MF A01
(Vol.2)	6:17004	NTIS, PC A19/MF A01
(Vol.2)	6:17005	NTIS, PC A19/MF A01
(Vol.2)	6:17006	NTIS, PC A19/MF A01
(Vol.2)	6:17007	NTIS, PC A19/MF A01
(Vol.2)	6:17008	NTIS, PC A19/MF A01
(Vol.2)	6:17009	NTIS, PC A19/MF A01
(Vol.2)	6:17010	NTIS, PC A19/MF A01
(Vol.2)	6:17011	NTIS, PC A19/MF A01
(Vol.2)	6:17012	NTIS, PC A19/MF A01
(Vol.2)	6:17013	NTIS, PC A19/MF A01
(Vol.2)	6:17014	NTIS, PC A19/MF A01
(Vol.2)	6:17015	NTIS, PC A19/MF A01
(Vol.2)	6:17016	NTIS, PC A19/MF A01
(Vol.2)	6:17017	NTIS, PC A19/MF A01
(Vol.2)	6:17018	NTIS, PC A19/MF A01
(Vol.2)	6:17019	NTIS, PC A19/MF A01
(Vol.2)	6:17020	NTIS, PC A19/MF A01
(Vol.2)	6:17021	NTIS, PC A19/MF A01
(Vol.2)	6:17022	NTIS, PC A19/MF A01
(Vol.2)	6:17023	NTIS, PC A19/MF A01
(Vol.2)	6:17024	NTIS, PC A19/MF A01
(Vol.2)	6:17025	NTIS, PC A19/MF A01
(Vol.2)	6:17026	NTIS, PC A19/MF A01
(Vol.2)	6:17027	NTIS, PC A19/MF A01
(Vol.2)	6:17028	NTIS, PC A19/MF A01
(Vol.2)	6:17029	NTIS, PC A19/MF A01
(Vol.2)	6:17030	NTIS, PC A19/MF A01
(Vol.2)	6:17031	NTIS, PC A19/MF A01
(Vol.2)	6:17032	NTIS, PC A19/MF A01
(Vol.2)	6:17053	NTIS, PC A19/MF A01
(Vol.2)	6:17054	NTIS, PC A19/MF A01
(Vol.2)	6:17055	NTIS, PC A19/MF A01
CONF-8004140-		(International Energy Agency workshop on enhanced oil recovery, Bartlesville, OK, USA, 24 Apr 1980)
	6:16466	NTIS, PC A13/MF A 01
	6:16467	NTIS, PC A13/MF A 01
	6:16468	NTIS, PC A13/MF A 01
	6:16469	NTIS, PC A13/MF A 01
	6:16470	NTIS, PC A13/MF A 01
	6:16471	NTIS, PC A13/MF A 01
	6:16472	NTIS, PC A13/MF A 01
	6:16473	NTIS, PC A13/MF A 01
	6:16474	NTIS, PC A13/MF A 01
	6:16475	NTIS, PC A13/MF A 01
	6:16476	NTIS, PC A13/MF A 01
	6:16477	NTIS, PC A13/MF A 01
	6:16478	NTIS, PC A13/MF A 01
	6:16479	NTIS, PC A13/MF A01
CONF-8004147-		(Annual meeting of the American Association of Physical Anthropologists, Niagara Falls, NY, USA, 19 Apr 1980)
1	6:17500	NTIS, PC A02/MF A01
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4	6:16840	*See* GEFR-SP-148
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4	6:17065	NTIS, PC A03/MF A01
CONF-800551-		(Symposium on neutron cross sections from 10 - 50 MeV, Upton, NY, USA, 12-14 May 1980)
(Vol.1)	6:17273	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17274	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17681	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17682	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17683	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17684	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17690	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17691	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17692	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17693	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17694	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17695	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17696	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17700	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17702	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17703	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17707	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17712	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17718	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17725	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17731	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17732	*See* DOE/NDC-21/L(Vol.1)
(Vol.1)	6:17737	*See* DOE/NDC-21/L(Vol.1)
(Vol.2)	6:17275	*See* DOE/NDC-21/L(Vol.2)
(Vol.2)	6:17685	*See* DOE/NDC-21/L(Vol.2)
(Vol.2)	6:17704	*See* DOE/NDC-21/L(Vol.2)
(Vol.2)	6:17713	*See* DOE/NDC-21/L(Vol.2)
(Vol.2)	6:17726	*See* DOE/NDC-21/L(Vol.2)
CONF-800567-		(International symposia alternative energy sources and technology, Montreal, Canada, 28-30 May 1980)
5	6:16667	NTIS, PC A02/MF A01
6	6:17451	NTIS, PC A02/MF A01
CONF-800592-		(International conference on postirradiation examination, Grange-Over-Sands, UK, 13-15 May 1980)
8	6:16826	NTIS, PC A02/MF A01
9	6:16856	NTIS, PC A02/MF A01
CONF-8005149-		(Physics and chemistry of energy - related atmospheric pollution, Harpers Ferry, WV, USA, 28-30 May 1980)
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CONF-8005151-		(Workshop on transportation accident scenarios involving spent fuel, Albuquerque, NM, USA, 6-8 May 1980)
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Report No.	Abstract No.	Availability
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CONF-800724-	(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)	
73	6:17652	*See* ANL-HEP-CP-80-60
75	6:17629	*See* DOE/ER/02232-97
CONF-800730-	(27. international field emission symposium, Tokyo, Japan, 7-12 Jul 1980)	
4	6:17080	NTIS, PC A02/MF A01
5	6:17081	NTIS, PC A02/MF A01
6	6:17082	NTIS, PC A02/MF A01
CONF-800740-	(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)	
27	6:17260	*See* LBL-10757
CONF-800782-	(SLAC/Summer Institute conference on the weak interaction, Menlo Park, CA, USA, 28 Jul-8 Aug 1980)	
	6:17300	*See* SLAC-239
	6:17301	*See* SLAC-239
	6:17302	*See* SLAC-239
	6:17303	*See* SLAC-239
	6:17304	*See* SLAC-239
	6:17316	*See* SLAC-239
	6:17317	*See* SLAC-239
	6:17318	*See* SLAC-239
	6:17319	*See* SLAC-239
	6:17320	*See* SLAC-239
	6:17562	*See* SLAC-239
	6:17632	*See* SLAC-239
	6:17633	*See* SLAC-239
	6:17634	*See* SLAC-239
	6:17635	*See* SLAC-239
	6:17636	*See* SLAC-239
	6:17637	*See* SLAC-239
	6:17638	*See* SLAC-239
	6:17639	*See* SLAC-239
	6:17640	*See* SLAC-239
	6:17641	*See* SLAC-239
	6:17658	*See* SLAC-239
	6:17659	*See* SLAC-239
	6:17660	*See* SLAC-239
	6:17661	*See* SLAC-239
	6:17672	*See* SLAC-239
	6:17741	*See* SLAC-239
	6:17742	*See* SLAC-239
CONF-800801-	(Annual meeting of the Electron Microscopy Society of America and 15. Microbeam Analysis Society Conference, San Francisco, CA, USA, 4-8 Aug 1980)	
10	6:17327	*See* HEDL-SA-2122-FP
CONF-800802-	(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)	
26	6:16893	*See* BNL-28956
CONF-800827-	(3. international conference on photochemical conversion and storage of solar energy, Golden, CO, USA, 3-8 Aug 1980)	
5	6:17186	*See* DOE/ER/10392-4
CONF-800850-	(International conference on effects of hydrogen on materials, Jackson Lake Lodge, WY, USA, 26-31 Aug 1980)	
5	6:17122	*See* DOE/ER/10430-7
CONF-800878-	(7. annual international conference on coal gasification, liquefaction, and conversion to electricity, Pittsburgh, PA, USA, 5-7 Aug 1980)	
2	6:16344	NTIS, PC A02/MF A01
CONF-800896-	(4. symposium on macrocyclic compounds, Provo, UT, USA, 11-13 Aug 1980)	
(Absts.)	6:17177	*See* DOE/ER/10605-4
CONF-800942-	(ANS topical meeting on 1980 advances in reactor physics and shielding, Sun Valley, ID, USA, 14-17 Sep 1980)	
21	6:16841	*See* HEDL-SA-2116
CONF-8009119-	(12. annual symposium on optical materials for high power lasers, Boulder, CO, USA, Sep 1980)	
3	6:17078	*See* UCRL-84843
CONF-8009139-	(International School of Subnuclear Physics conference, Geneva, Switzerland, Sep 1980)	
1	6:17653	*See* ANL-HEP-CP-80-64
CONF-801011-	(4. ANS topical meeting on the technology of controlled nuclear fusion, King of Prussia, PA, USA, 14-17 Oct 1980)	
82	6:17828	*See* BNL-29190
CONF-801038-	(16. DOE nuclear air cleaning conference, San Diego, CA, USA, 20-23 Oct 1980)	
20	6:16872	*See* HEDL-SA-2121-FP
CONF-801053-	(8. water reactor safety research information meeting, Gaithersburg, MD, USA, 27-31 Oct 1980)	
11	6:16860	NTIS, PC A02/MF A01
CONF-801068-	(2. international symposium on the production and neutralization of negative hydrogen ions and beams, Upton, NY, USA, 6 Oct 1980)	
	6:17567	*See* BNL-51304
	6:17568	*See* BNL-51304
	6:17569	*See* BNL-51304
	6:17570	*See* BNL-51304
	6:17571	*See* BNL-51304
	6:17572	*See* BNL-51304
	6:17573	*See* BNL-51304
	6:17574	*See* BNL-51304
	6:17575	*See* BNL-51304
	6:17576	*See* BNL-51304
	6:17577	*See* BNL-51304
	6:17578	*See* BNL-51304
	6:17579	*See* BNL-51304
	6:17580	*See* BNL-51304
	6:17581	*See* BNL-51304
	6:17582	*See* BNL-51304
	6:17583	*See* BNL-51304
	6:17584	*See* BNL-51304
	6:17585	*See* BNL-51304
	6:17586	*See* BNL-51304
	6:17587	*See* BNL-51304
	6:17588	*See* BNL-51304
	6:17589	*See* BNL-51304
	6:17590	*See* BNL-51304
	6:17591	*See* BNL-51304
	6:17592	*See* BNL-51304
	6:17593	*See* BNL-51304
CONF-8010159-	(Fall meeting of the Electrochemical Society, Hollywood, FL, USA, 5-10 Oct 1980)	
1	6:17071	*See* UCRL-84445
2	6:17092	*See* DOE/ER/10430-8
3	6:17093	*See* DOE/ER/10430-9
CONF-8010168-	(European seminar on radiation protection quantities for external exposure, Braunschweig, F.R. Germany, 13-15 Oct 1980)	
1	6:17743	*See* LBL-11652
CONF-8010169-	(1980 ASQC western regional conference, Portland, OR, USA, 16-18 Oct 1980)	
1	6:16842	*See* HEDL-SA-2200
CONF-8010171-	(2. symposium on valves for coal conversion and utilization, Morgantown, WV, USA, 15-17 Oct 1980)	
	6:16357	*See* DOE/MC/14522-1
	6:16358	*See* DOE/MC/14522-1
	6:16359	*See* DOE/MC/14522-1
	6:16360	*See* DOE/MC/14522-1
	6:16361	*See* DOE/MC/14522-1
	6:16362	*See* DOE/MC/14522-1
	6:16363	*See* DOE/MC/14522-1
	6:16364	*See* DOE/MC/14522-1
	6:16365	*See* DOE/MC/14522-1
	6:16366	*See* DOE/MC/14522-1
	6:16367	*See* DOE/MC/14522-1
CONF-8010174-	(Joint US/Australian workshop on forage evaluation and utilization: an appraisal of concepts and techniques, Armidale, Australia, 27-31 Oct 1980)	
1	6:17511	*See* LA-UR-81-748
CONF-801103-	(IEEE nuclear science symposium, Orlando, FL, USA, 5-7 Nov 1980)	
56	6:17491	*See* LBL-11858
CONF-801104-	(73. annual meeting of the American Institute of Chemical Engineers, Chicago, IL, USA, 12-16 Nov 1980)	
13	6:17239	NTIS, PC A03/MF A01
CONF-801107-	(ANS international conference, Washington, DC, USA, 17-21 Nov 1980)	
70	6:17206	*See* HEDL-SA-2191

Report No.	Abstract No.	Availability
CONF-801114-		(Symposium on plumes and visibility, Grand Canyon, AZ, USA, 10-14 Nov 1980)
10	6:17349	*See* BNL-29271
CONF-801124-		(3. annual meeting of the Materials Research Society, Boston, MA, USA, 17-20 Nov 1980)
47	6:16567	*See* PNL-SA-9054
CONF-801139-		(Electro-optics/laser conference, Boston, MA, USA, 19-21 Nov 1980)
2	6:17235	*See* BDX-613-2507
CONF-801170-		(14. Asilomar conference on circuits, systems and computers, Pacific Grove, CA, USA, 17-19 Nov 1980)
1	6:17886	*See* UCRL-84549
CONF-801172-		(Tree crops for energy co-production on farms, Estes Park, CO, USA, 12-14 Nov 1980)
	6:16658	*See* SERI/CP-622-1086
	6:16659	*See* SERI/CP-622-1086
CONF-801187-		(Contractors review on biological effects from electric fields associated with high voltage transmission lines, Washington, DC, USA, 18-19 Nov 1980)
(Absts.)	6:17538	NTIS, PC A03/MF A01
CONF-801189-		(National Fire Protection Association fall meeting, San Diego, CA, USA, 17-20 Nov 1980)
1	6:16857	*See* HEDL-SA-1985
CONF-801208-		(Annual IPH conference, Houston, TX, USA, 16-19 Dec 1980)
3	6:16704	*See* SERI/TP-632-1123
CONF-801210-		(3. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 15-17 Dec 1980)
24	6:17829	NTIS, PC A02/MF A01
CONF-801242-		(Electric and hybrid vehicle advanced technology seminar, Pasadena, CA, USA, 8-9 Dec 1980)
4	6:17073	*See* UCRL-85425
5	6:17072	*See* UCRL-85390
6	6:17069	*See* DOE/NASA/51044-17
CONF-801244-		(Workshop on weak interactions as probes of unification, Blacksburg, VA, USA, 3-6 Dec 1980)
4	6:17627	*See* BNL-29072
5	6:17631	*See* LBL-12275
6	6:17669	*See* BNL-29074
CONF-810103-		(Measurement science conference, Anaheim, CA, USA, 30-31 Jan 1981)
2	6:17745	*See* SLAC-PUB-2662
CONF-810113-		(Simulation methods for nuclear power systems conference, Tucson, AZ, USA, Jan 1981)
6	6:17898	*See* SAND-81-0013
CONF-810116-		(5. annual IGT meeting on energy from biomass and wastes, Lake Buena Vista, FL, USA, 26-30 Jan 1981)
2	6:16664	Chicago, IL; Institute of Gas Technology (1981).
CONF-810120-		(Workshop on the impact of hydrogen on water reactor safety, Albuquerque, NM, USA, 26-28 Jan 1981)
8	6:16873	*See* LA-UR-81-681
CONF-810131-		(California symposium on acid precipitation, San Francisco, CA, USA, 13-15 Jan 1981)
1	6:17527	*See* BNL-29097
CONF-810132-		(IIMASS workshop on numerical analysis, Mexico City, Mexico, 12-16 Jan 1981)
1	6:17227	*See* KAPL-4139
CONF-810133-		(International symposium on early results of FGGE-MONEX experiments, Tallahassee, FL, USA, 12-17 Jan 1981)
1	6:17342	*See* BNL-29260
CONF-810203-		(AIME annual meeting, Chicago, IL, USA, 22-26 Feb 1981)
7	6:16444	NTIS, PC A02/MF A01
9	6:17085	*See* DOE/ER/01198-1343
CONF-810214-		(4. topical conference on radio frequency plasma heating, Austin, TX, USA, 9-10 Feb 1981)
4	6:17761	*See* GA-A-16194
5	6:17767	*See* LA-UR-81-682
CONF-810217-		(ANS waste management conference, Tucson, AZ, USA, 23-26 Feb 1981)
12	6:16561	*See* LA-UR-81-830
CONF-810219-		(Symposium on the genotoxic effects of airborne agents, Upton, NY, USA, Feb 1981)
2	6:17528	*See* BNL-29259
CONF-810226-		(2. DOE/NASA wind turbine dynamics workshop, Cleveland, OH, USA, 24-26 Feb 1981)
3	6:16782	*See* SAND-80-2669C
CONF-810227-		(SAS users group international meeting, Lake Buena Vista, FL, USA, 8-11 Feb 1981)
2	6:17428	NTIS, PC A02/MF A01
CONF-810234-		(Army Research office workshop on multiphase flow, Aberdeen Proving Ground, MD, USA, 2-4 Feb 1981)
1	6:17224	*See* BNL-29189
CONF-810235-		(SPIE technical symposium, Los Angeles, CA, USA, 9-13 Feb 1981)
1	6:16861	NTIS, PC A02/MF A01
CONF-810236-		(10. annual symposium on applied vacuum science and technology, Tampa, FL, USA, 9-11 Feb 1981)
1	6:17234	*See* GEPP-OP-563
CONF-810238-		(3. international cadium conference, Miami, FL, USA, 3-5 Feb 1981)
1	6:17525	*See* BNL-29064
2	6:17526	*See* BNL-29066
CONF-810240-		(Symposium on capacitor technologies, applications and reliability, Huntsville, AL, USA, 24-25 Feb 1981)
1	6:16877	*See* SAND-81-0067C
CONF-810243-		(Workshop on mucociliary clearance, Miami Beach, FL, USA, 17-19 Feb 1981)
1	6:17503	*See* UR-3490-1977
CONF-810306-		(5. symposium on turbulence, diffusion, and air pollution, Atlanta, GA, USA, 9-13 Mar 1981)
1	6:17353	*See* LA-UR-80-3052
6	6:17345	*See* UCRL-84672
CONF-810307-		(3. specialist meeting on transient two-phase flow, Pasadena, CA, USA, 23-25 Mar 1981)
3	6:16862	NTIS, PC A02/MF A01
CONF-810308-		(American Chemical Society symposium on the chemistry of engine combustion deposits, Atlanta, GA, USA, 29 Mar-3 Apr 1981)
10	6:16395	NTIS, PC A02/MF A01
11	6:16465	NTIS, PC A03/MF A01
CONF-810314-		(Particle accelerator conference, Washington, DC, USA, 11-13 Mar 1981)
39	6:17256	*See* DOE/ER/40014-1
64	6:17289	*See* BNL-29196
65	6:17296	*See* BNL-29241
66	6:17294	*See* BNL-29232
67	6:17251	*See* BNL-29201
68	6:17291	*See* BNL-29209
69	6:17254	*See* BNL-29215
70	6:17269	*See* BNL-29226
71	6:17253	*See* BNL-29212
72	6:17268	*See* BNL-29213
73	6:17827	*See* BNL-29159
74	6:17270	*See* BNL-29242
75	6:17265	*See* BNL-29187
76	6:17267	*See* BNL-29210
77	6:17252	*See* BNL-29211
78	6:17261	*See* BNL-29083
79	6:17264	*See* BNL-29176
80	6:17263	*See* BNL-29174
81	6:17266	*See* BNL-29208
82	6:17272	NTIS, PC A02/MF A01
83	6:17255	*See* BNL-29295
84	6:17283	*See* UCRL-85060
85	6:17279	*See* LA-UR-81-772
86	6:17277	*See* LA-UR-81-731
87	6:17257	*See* LA-UR-81-730
88	6:17258	*See* LA-UR-81-737
89	6:17278	*See* LA-UR-81-746
90	6:17293	*See* BNL-29218
91	6:17287	*See* BNL-29194
92	6:17262	*See* BNL-29148
93	6:17288	*See* BNL-29195
94	6:17290	*See* BNL-29197
95	6:17285	*See* BNL-29091
96	6:17292	*See* BNL-29217
97	6:17295	*See* BNL-29236
98	6:17286	*See* BNL-29188
99	6:17271	*See* BNL-29305
100	6:17282	*See* UCRL-85037
101	6:17209	*See* LA-UR-81-831
102	6:17259	*See* LA-UR-81-784
103	6:17281	*See* LA-UR-81-805
104	6:17249	*See* LA-UR-81-818
106	6:17299	*See* LA-UR-81-781
107	6:17280	*See* LA-UR-81-783
CONF-810315-		(8. energy technology conference and exposition, Washington, DC, USA, 9-11 Mar 1981)
8	6:16948	NTIS, PC A02/MF A01
9	6:16633	*See* SERI/TP-731-1128

Report No.	Abstract No.	Availability
CONF-810321-		(SPE California regional meeting, Bakersfield, CA, USA, 25-27 Mar 1981)
3	6:16753	*See* LBL-12220
CONF-810325-		(Workshop on measurement of electrical quantities in pulsed power systems, Boulder, CO, USA, 2-4 Mar 1981)
1	6:17881	*See* SAND-80-2685C
CONF-810331-		(Conference on tetrahedrally bonded amorphous semiconductors, Carefree, AZ, USA, 12-14 Mar 1981)
1	6:16637	*See* BNL-29160
2	6:17137	*See* BNL-29161
CONF-810334-		(Workshop on high speed computing, Gleneden Beach, OR, USA, 31 Mar 1981)
1	6:17625	*See* UCRL-85677-VUGRAPH
3	6:17901	*See* UCRL-85679
4	6:17902	*See* UCRL-85680(VUGRAPH)
CONF-810336-		(South Carolina Academy of Sciences meeting, Columbia, SC, USA, 26-28 Mar 1981)
1	6:17543	*See* DP-MS-80-131
CONF-810337-		(Workshop to delineate the economics, technical and policy issues for remote maintenance in energy systems, Gainesville, FL, USA, 9-10 Mar 1981)
1	6:16553	NTIS, PC A02/MF A01
CONF-810339-		(4. international conference on stable isotopes, Julich, F.R. Germany, 23-26 Mar 1981)
1	6:17168	*See* MLM-2815(OP)
2	6:17157	*See* LA-UR-81-898
CONF-810340-		(7. international conference on magnet technology, Karlsrube, F.R. Germany, 30 Mar-3 Apr 1981)
1	6:17887	*See* UCRL-85073
2	6:17079	*See* BNL-29256
3	6:17297	*See* BNL-29307
CONF-810341-		(ASCE spring conference, Las Cruces, NM, USA, 27 Mar 1981)
1	6:16718	*See* SAND-80-7076
CONF-810342-		(13. symposium on the computer science and statistics interface, Pittsburgh, PA, USA, 12-13 Mar 1981)
1	6:17897	*See* LA-UR-81-1024
CONF-810343-		(ASHRAE Richmond chapter conference, Richmond, VA, USA, 18 Mar 1981)
1	6:17041	NTIS, PC A02/MF A01
CONF-810345-		(1. SERI solar hydrogen production program contractors' review meeting, Washington, DC, USA, 26-27 Mar 1981)
1	6:16593	NTIS, PC A02/MF A01
CONF-810346-		(Instrument Society of America symposium, St Louis, MO, USA, 23 Mar 1981)
1	6:17350	NTIS, PC A02/MF A01
CONF-810347-		(NACE international conference on high temperature corrosion, San Diego, CA, USA, 2-6 Mar 1981)
1	6:16379	*See* LBL-12152
CONF-810350-		(ICN-UCLA symposium on molecular and cellular biology, Keystone, CO, USSR, 15-20 Mar 1981)
1	6:17529	NTIS, PC A02/MF A01
CONF-810402-		(Corrosion/81 annual meeting, Toronto, Canada, 6-10 Apr 1981)
9	6:16345	NTIS, PC A03/MF A01
CONF-810405-		(3. annual systems simulation, economic analysis/ solar heating and cooling operational results conference, Reno, NV, USA, 27 Apr-1 May 1981)
13	6:16630	*See* SERI/TR-633-1063
14	6:16706	*See* SERI/TR-731-905
CONF-810409-		(IAEA international symposium on methods of low-level counting and spectrometry, Berlin, F.R. Germany, 6-10 Apr 1981)
3	6:17326	*See* DP-MS-80-105
CONF-810410-		(Scanning electron microscopy conference, Dallas, TX, USA, 14-18 Apr 1981)
2	6:17125	*See* SAND-81-0063C
CONF-810411-		(4. symposium on training of nuclear facility personnel, Gatlinburg, TN, USA, 27-29 Apr 1981)
	6:16814	NTIS, PC A15/MF A01
	6:16815	NTIS, PC A15/MF A01
	6:16816	NTIS, PC A15/MF A01
	6:16817	NTIS, PC A15/MF A01
	6:16818	NTIS, PC A15/MF A01
	6:16819	NTIS, PC A15/MF A01
	6:16820	NTIS, PC A15/MF A01
	6:16821	NTIS, PC A15/MF A01
	6:16822	NTIS, PC A15/MF A01
	6:16823	NTIS, PC A15/MF A01
	6:16824	NTIS, PC A15/MF A01
	6:16825	NTIS, PC A15/MF A01
	6:16830	NTIS, PC A15/MF A01
	6:16831	NTIS, PC A15/MF A01
	6:16847	NTIS, PC A15/MF A01
	6:16852	NTIS, PC A15/MF A01
	6:16863	NTIS, PC A15/MF A01
CONF-810417-		(90. AICHE national meeting, Houston, TX, USA, 5-9 Apr 1981)
3	6:16389	*See* SAND-81-0968C
CONF-810421-		(Ionospheric effects symposium, Alexandria, VA, USA, 14-16 Apr 1981)
2	6:17565	*See* LA-UR-81-870
CONF-810423-		(1. International Energy Agency (IEA) conference on new energy conservation technologies and their commercialization, Berlin, F.R. Germany, 6-10 Apr 1981)
4	6:16964	*See* LBL-12280
CONF-810425-		(International conference on metallurgical coatings, San Francisco, CA, USA, 6-10 Apr 1981)
1	6:17077	*See* SAND-81-0570C
3	6:17131	*See* SAND-81-0806C
4	6:17144	*See* SAND-81-0475C
5	6:17108	*See* SAND-80-2431C
CONF-810427-		(SME international tool and manufacturing engineering conference and exposition, Detroit, MI, USA, 27-30 Apr 1981)
1	6:17107	*See* RFP-3195
2	6:17228	*See* RFP-3198
CONF-810428-		(Symposium on molecular and cellular mechanisms of mutagenesis, Gatlinburg, TN, USA, 6-9 Apr 1981)
(Absts.)	6:17530	NTIS, PC A03/MF A01
CONF-810429-		(Conference on optics, Santa Fe, NM, USA, 6-10 Apr 1981)
1	6:17328	*See* LA-UR-81-679
2	6:17142	*See* LA-UR-81-1021
3	6:17768	*See* LA-UR-81-896
4	6:17102	*See* LA-UR-81-747
5	6:17755	*See* LA-UR-81-994
CONF-810431-		(IDMS User Association data base conference, Atlanta, GA, USA, 5-8 Apr 1981)
1	6:17892	NTIS, PC A02/MF A01
CONF-810433-		(IEEE region 3 southeastern conference and exhibit, Huntsville, AL, USA, 5-8 Apr 1981)
1	6:16804	NTIS, PC A02/MF A01
CONF-810434-		(2. international symposium on flow, St Louis, MO, USA, 6-10 Apr 1981)
1	6:16864	NTIS, PC A02/MF A01
2(Draft)	6:17225	NTIS, PC A03/MF A01
3	6:16865	NTIS, PC A02/MF A01
CONF-810435-		(District heating technical training workshop, Washington, DC, USA, 1-3 Apr 1981)
1	6:17042	NTIS, PC A02/MF A01
CONF-810436-		(Environmetrics '81 conference, Washington, DC, USA, 6-8 Apr 1981)
1	6:17893	NTIS, PC A02/MF A01
CONF-810437-		(6. international symposium on noise in physical systems, Washington, DC, USA, 6-10 Apr 1981)
1	6:17325	NTIS, PC A02/MF A01
CONF-810439-		(15. AIAA/JSASS/DGLR international electromagnetic propulsion conference, Las Vegas, NV, USA, 21-23 Apr 1981)
2	6:16859	*See* LA-UR-81-703
CONF-810505-		(Institute of Environmental Sciences annual meeting, Los Angeles, CA, USA, 4-7 May 1981)
3	6:17354	*See* LA-UR-81-729
CONF-810506-		(39. Society of Plastics Engineers annual technical conference, Boston, MA, USA, 4-7 May 1981)
1	6:17133	*See* UCRL-84039
CONF-810509-		(Annual conference of the International Solar Energy Society, Philadelphia, PA, USA, 26-30 May 1981)
1	6:16725	NTIS, PC A02/MF A01
4	6:16378	*See* LA-UR-81-764
6	6:16712	*See* LA-UR-81-1023
7	6:16669	*See* DOE/ET/20279-122
8	6:16668	*See* DOE/ET/20279-120
9	6:16671	*See* DOE/ET/20279-129
10	6:16681	*See* SERI/TP-633-1148
11	6:16703	*See* SERI/TP-631-1159
12	6:16978	*See* SERI/TP-721-1133
13	6:16717	*See* SAND-80-2504C
CONF-810518-		(Joint SPE/DOE symposium, Denver, CO, USA, 27-29 May 1981)
1	6:16510	*See* SAND-81-0371C
2	6:16511	*See* SAND-81-0387C
3	6:16508	*See* LA-UR-81-736

Report No.	Abstract No.	Availability
4	6:16507	*See* LA-UR-81-735
5	6:16520	*See* SAND-80-2307C
7	6:16519	*See* SAND-80-2219C
CONF-810519-	(Workshop on alternate nuclear waste forms and interactions in geologic media, Gatlinburg, TN, USA, 13-15 May 1981)	
1	6:16572	*See* UCRL-85032
CONF-810520-	(Symposium on separation science and technology for energy applications, Gatlinburg, TN, USA, 5-8 May 1981)	
1	6:16550	*See* MLM-2816(OP)
CONF-810526-	(15. IEEE PV specialists conference, Orlando, FL, USA, 11-15 May 1981)	
1	6:16670	*See* DOE/ET/20279-126
CONF-810528-	(83. symposium on nucleation and crystallization in glasses, Washington, DC, USA, 3-6 May 1981)	
1	6:17124	*See* SAND-80-2613C
COO-		
3246-20	6:17724	*See* DOE/ER/13246-20
4592-2	6:16827	*See* DOE/ET/34216-T1
4938-4	6:17754	*See* DOE/ER/04938-T1
4946-3	6:16602	NTIS, PC A03/MF A01
DOE/AD/06212-		
1	6:17424	NTIS, PC A04/MF A01
DOE/AL/10563-		
T8(Vol.1)	6:16749	NTIS, PC A05/MF A01
T8(Vol.2)	6:16750	NTIS, PC A05/MF A01
T8(Vol.3)	6:16751	NTIS, PC A09/MF A01
T8(Vol.4)	6:16752	NTIS, PC A04/MF A01
DOE/AL/10752-		
10	6:16582	NTIS, PC A04/MF A01
DOE/BC/10069-		
10	6:16480	NTIS, PC A10/MF A01
DOE/BETC-		
80/ 4	6:16481	NTIS, PC A09/MF A01
DOE/BP/01310-		
T1	6:16764	NTIS, PC A07/MF A01
T1(App.1)	6:16765	NTIS, PC A06/MF A01
T1(App.2)	6:16766	NTIS, PC A05/MF A01
DOE/CS-		
0026/ 13	6:17066	NTIS, PC A03/MF A01
0130/ 4	6:17067	NTIS, PC A07/MF A01
DOE/CS/20068-		
4	6:17044	NTIS, PC A15/MF A01
5	6:17045	NTIS, PC A12/MF A01
DOE/CS/24310-		
2	6:16603	NTIS, PC A02/MF A01
DOE/CS/30062-		
1	6:16693	NTIS, PC A25/MF A01
DOE/CS/31713-		
T1	6:16694	NTIS, PC A06/MF A01
DOE/CS/32223-		
T1	6:16695	NTIS, PC A14/MF A01
DOE/CS/34510-		
T1	6:16696	NTIS, PC A14/MF A01
DOE/CS/40015-		
T2	6:17033	NTIS, PC A14/MF A01
DOE/CS/40041-		
1	6:17034	NTIS, PC A02/MF A01
DOE/CS/40092-		
T1	6:17035	NTIS, PC A10/MF A01
DOE/CS/40153-		
T1	6:17083	NTIS, PC A02/MF A01
DOE/CS/54209-		
T1	6:17068	NTIS, PC A08/MF A01
DOE/DP/40013-		
1	6:17138	NTIS, PC A03/MF A01
DOE/DP/40070-		
1	6:17220	NTIS, PC A11/MF A01
DOE/DP/40083-		
1	6:16585	NTIS, PC A07/MF A01
DOE/DP/40095-		
T1	6:17118	NTIS, PC A02/MF A01
DOE/DP/40109-		
2	6:17830	NTIS, PC A02/MF A01
DOE/EI/10416-		
1	6:16959	NTIS, PC A10/MF A01
DOE/EIA-		
0095(79)	6:16927	NTIS, PC A24/MF A01
0129(79)	6:16513	NTIS, PC A04/MF A01
0174(80/ 2)	6:16710	NTIS, PC A03/MF A01
DOE/ER-		
0045/ 5	6:17084	NTIS, PC A13/MF A01
03077-170	6:17226	NTIS, PC A10/MF A01
DOE/ER/00038-		
2210	6:17189	NTIS, PC A03/MF A01
DOE/ER/01198-		
1343	6:17085	NTIS, PC A02/MF A01
DOE/ER/01545-		
289	6:17654	NTIS, PC A02/MF A01
301	6:17670	NTIS, PC A03/MF A01
DOE/ER/01764-		
382	6:17674	NTIS, PC A03/MF A01
397	6:17628	NTIS, PC A02/MF A01
DOE/ER/01885-		
T1	6:17139	NTIS, PC A03/MF A01
DOE/ER/02232-		
97	6:17629	NTIS, PC A02/MF A01
DOE/ER/02305-		
T1	6:17746	NTIS, PC A02/MF A01
DOE/ER/02313-		
T1	6:17086	NTIS, PC A04/MF A01
DOE/ER/02383-		
0078	6:17894	NTIS, PC A03/MF A01
T1	6:17895	NTIS, PC A04/MF A01
T2	6:17896	NTIS, PC A07/MF A01
DOE/ER/02462-		
T1	6:17087	NTIS, PC A03/MF A01
DOE/ER/02755-		
5	6:17465	NTIS, PC A08/MF A01
DOE/ER/02899-		
T2	6:17140	NTIS, PC A06/MF A01
DOE/ER/02923-		
4	6:17119	NTIS, PC A02/MF A01
DOE/ER/02960-		
T1	6:17185	NTIS, PC A04/MF A01
DOE/ER/03072-		
T3	6:17630	NTIS, PC A12/MF A01
DOE/ER/03130-		
T1	6:17675	NTIS, PC A02/MF A01
T2	6:17676	NTIS, PC A05/MF A01
DOE/ER/04441-		
4	6:17120	NTIS, PC A03/MF A01
DOE/ER/04475-		
2	6:16639	NTIS, PC A02/MF A01
DOE/ER/04799-		
2	6:17088	NTIS, PC A02/MF A01
DOE/ER/04900-		
1	6:16604	NTIS, PC A02/MF A01
DOE/ER/04927-		
T1	6:17466	NTIS, PC A02/MF A01
T2	6:17467	NTIS, PC A02/MF A01
T3	6:17468	NTIS, PC A03/MF A01
T4	6:16640	NTIS, PC A02/MF A01
DOE/ER/04936-		
6	6:17722	NTIS, PC A03/MF A01
DOE/ER/04938-		
T1	6:17754	NTIS, PC A02/MF A01
DOE/ER/04971-		
3	6:17594	NTIS, PC A03/MF A01
DOE/ER/04993-		
T1	6:17089	NTIS, PC A02/MF A01
DOE/ER/05002-		
15	6:17090	NTIS, PC A03/MF A01
16	6:17747	NTIS, PC A04/MF A01
DOE/ER/05246-		
T1	6:16599	NTIS, PC A04/MF A01
DOE/ER/06036-		
1	6:17595	NTIS, PC A03/MF A01
DOE/ER/10004-		
3	6:16901	NTIS, PC A03/MF A01
DOE/ER/10107-		
1	6:17832	NTIS, PC A06/MF A01
DOE/ER/10125-		
1	6:16902	NTIS, PC A02/MF A01
DOE/ER/10375-		
T1	6:17748	NTIS, PC A02/MF A01
DOE/ER/10382-		
2	6:17121	NTIS, PC A02/MF A01
DOE/ER/10392-		
4	6:17186	NTIS, PC A02/MF A01
DOE/ER/10402-		
T1	6:17655	NTIS, PC A02/MF A01
DOE/ER/10405-		
2	6:17701	NTIS, PC A03/MF A01
DOE/ER/10418-		
T1	6:17699	NTIS, PC A02/MF A01
DOE/ER/10421-		
T1	6:17130	NTIS, PC A02/MF A01
DOE/ER/10423-		
T2	6:17560	NTIS, PC A04/MF A01
DOE/ER/10428-		
2	6:17117	NTIS, PC A02/MF A01

Report No.	Abstract No.	Availability
DOE/ER/10429-T2	6:17091	NTIS, PC A02/MF A01
DOE/ER/10430-7	6:17122	NTIS, PC A02/MF A01
DOE/ER/10430-8	6:17092	NTIS, PC A02/MF A01
DOE/ER/10430-9	6:17093	NTIS, PC A02/MF A01
DOE/ER/10430-T1	6:17094	NTIS, PC A02/MF A01
DOE/ER/10433-2	6:17095	NTIS, PC A03/MF A01
DOE/ER/10434-2	6:17723	NTIS, PC A04/MF A01
DOE/ER/10436-2	6:17749	NTIS, PC A02/MF A01
DOE/ER/10439-2	6:17164	NTIS, PC A02/MF A01
DOE/ER/10440-2	6:17750	NTIS, PC A03/MF A01
DOE/ER/10450-1	6:17096	NTIS, PC A08/MF A01
DOE/ER/10453-2	6:17123	NTIS, PC A02/MF A01
DOE/ER/10454-1	6:17596	NTIS, PC A02/MF A01
DOE/ER/10456-2	6:16453	NTIS, PC A02/MF A01
DOE/ER/10466-1	6:16445	NTIS, PC A03/MF A01
DOE/ER/10496-2	6:17597	NTIS, PC A03/MF A01
DOE/ER/10514-12	6:17598	NTIS, PC A04/MF A01
DOE/ER/10587-1	6:17671	NTIS, PC A02/MF A01
DOE/ER/10605-4	6:17177	NTIS, PC A03/MF A01
DOE/ER/10612-2	6:17165	NTIS, PC A03/MF A01
DOE/ER/10660-1	6:17187	NTIS, PC A02/MF A01
DOE/ER/10677-1	6:17201	NTIS, PC A02/MF A01
DOE/ER/10740-1	6:17298	NTIS, PC A03/MF A01
DOE/ER/10746-T1	6:17599	NTIS, PC A02/MF A01
DOE/ER/10774-1	6:17561	NTIS, PC A02/MF A01
DOE/ER/13246-20	6:17724	NTIS, PC A05/MF A01
DOE/ER/40014-1	6:17256	NTIS, PC A02/MF A01
DOE/ER/70218-T2	6:17178	NTIS, PC A02/MF A01
DOE/ET/04502-7	6:16402	NTIS, PC A07/MF A01
DOE/ET/10254-88	6:16346	NTIS, PC A05/MF A01
DOE/ET/10280-T1	6:16347	NTIS, PC A12/MF A01
DOE/ET/10296-71	6:16348	NTIS, PC A03/MF A01
DOE/ET/10404-2	6:17097	NTIS, PC A04/MF A01
DOE/ET/10463-T1(Vol.2)	6:16349	NTIS, PC A15/MF A01
DOE/ET/11268-6	6:16460	NTIS, PC A08/MF A01
DOE/ET/11268-9	6:16425	NTIS, PC A09/MF A01
DOE/ET/12047-52(Vol.1)	6:16482	NTIS, PC A06/MF A01
DOE/ET/12047-52(Vol.2)	6:16483	NTIS, PC A20/MF A01
DOE/ET/12047-52(Vol.3)	6:16484	NTIS, PC A15/MF A01
DOE/ET/12056-20	6:16485	NTIS, PC A03/MF A01
DOE/ET/12075-2	6:16486	NTIS, PC A05/MF A01
DOE/ET/12138-T2	6:16463	NTIS, PC A08/MF A01
DOE/ET/12138-T3	6:16464	NTIS, PC A10/MF A01
DOE/ET/12346-T1	6:16941	NTIS, PC A02/MF A01
DOE/ET/12543-1	6:16426	NTIS, PC A07/MF A01
DOE/ET/13005-T2	6:16350	NTIS, PC A04/MF A01
DOE/ET/13116-T13	6:17056	NTIS, PC A04/MF A01
DOE/ET/13513-T8	6:17098	NTIS, PC A03/MF A01
DOE/ET/13513-T9	6:17099	NTIS, PC A03/MF A01
DOE/ET/14317-T2(Vol.1)	6:16487	NTIS, PC A06/MF A01
DOE/ET/14674-T1	6:16351	NTIS, PC A02/MF A01
DOE/ET/14801-6	6:16352	NTIS, PC A04/MF A01
DOE/ET/14801-9	6:16353	NTIS, PC A04/MF A01
DOE/ET/14815-20	6:16354	NTIS, PC A08/MF A01
DOE/ET/14815-20	6:16355	NTIS, PC A08/MF A01
DOE/ET/15208-T1(Vol.1)	6:16784	NTIS, PC A03/MF A01
DOE/ET/15208-T1(Vol.2)	6:16785	NTIS, PC A11/MF A01
DOE/ET/15397-T3	6:17057	NTIS, PC A03/MF A01
DOE/ET/15422-6	6:16945	NTIS, PC A04/MF A01
DOE/ET/15492-T12	6:16403	NTIS, PC A03/MF A01
DOE/ET/15529-9	6:16942	NTIS, PC A05/MF A01
DOE/ET/15611-1	6:16943	NTIS, PC A18/MF A01
DOE/ET/17089-T1	6:16949	NTIS, PC A04/MF A01
DOE/ET/20030-1	6:16614	NTIS, PC A99/MF A01
DOE/ET/20050-T4	6:16605	NTIS, PC A07/MF A01
DOE/ET/20279-120	6:16668	NTIS, PC A02/MF A01
DOE/ET/20279-122	6:16669	NTIS, PC A02/MF A01
DOE/ET/20279-126	6:16670	NTIS, PC A02/MF A01
DOE/ET/20279-129	6:16671	NTIS, PC A02/MF A01
DOE/ET/20283-2	6:16772	NTIS, PC A08/MF A01
DOE/ET/20283-3	6:16773	NTIS, PC A03/MF A01
DOE/ET/20413-T1	6:16711	NTIS, PC A02/MF A01
DOE/ET/23003-3	6:16641	NTIS, PC A02/MF A01
DOE/ET/23036-4	6:16642	NTIS, PC A04/MF A01
DOE/ET/23037-1	6:16643	NTIS, PC A02/MF A01
DOE/ET/23106-4	6:16644	NTIS, PC A06/MF A01
DOE/ET/25202-1(Vol.1)	6:16672	NTIS, PC A09/MF A01
DOE/ET/25202-1(Vol.2)	6:16673	NTIS, PC A13/MF A01
DOE/ET/27002-1	6:16729	NTIS, PC A09/MF A01
DOE/ET/27002-2	6:16730	NTIS, PC A05/MF A01
DOE/ET/28392-23	6:16731	NTIS, PC A03/MF A01
DOE/ET/28392-25	6:16732	NTIS, PC A04/MF A01
DOE/ET/28392-31	6:16727	NTIS, PC A04/MF A01
DOE/ET/28392-32	6:16733	NTIS, PC A07/MF A01
DOE/ET/29102-1	6:16805	NTIS, PC A99/MF A01
DOE/ET/29185-18	6:16806	NTIS, PC A02/MF A01
DOE/ET/29185-19	6:16807	NTIS, PC A02/MF A01
DOE/ET/34202-15	6:16833	NTIS, PC A09/MF A01
DOE/ET/34216-T1	6:16827	NTIS, PC A03/MF A01
DOE/ET/34216-T2	6:16828	NTIS, PC A05/MF A01
DOE/ET/37218-1	6:16866	NTIS, PC A08/MF A01
DOE/ET/37218-2	6:16867	NTIS, PC A12/MF A01
DOE/ET/37218-3	6:16868	NTIS, PC A09/MF A01
DOE/ET/37218-4	6:16869	NTIS, PC A16/MF A01
DOE/ET/51010-9	6:17833	NTIS, PC A04/MF A01
DOE/ET/53048-3	6:17760	NTIS, PC A02/MF A01
DOE/EV/00639-22	6:17429	NTIS, PC A05/MF A01
DOE/EV/00889-7(Vol.1)	6:17555	NTIS, PC A08/MF A01
DOE/EV/00889-7(Vol.2)	6:17556	NTIS, PC A08/MF A01
DOE/EV/00889-7(Vol.3)	6:17557	NTIS, PC A19/MF A01

Report No.	Abstract No.	Availability
DOE/EV/02401-		
T1	6:17502	NTIS, PC A02/MF A01
DOE/EV/02412-		
105	6:17531	NTIS, PC A04/MF A01
DOE/EV/03017-		
43	6:17532	NTIS, PC A03/MF A01
T1	6:17469	NTIS, PC A02/MF A01
DOE/EV/04115-		
4	6:17192	NTIS, PC A07/MF A01
4	6:17193	NTIS, PC A07/MF A01
4	6:17194	NTIS, PC A07/MF A01
4	6:17195	NTIS, PC A07/MF A01
4	6:17196	NTIS, PC A07/MF A01
4	6:17197	NTIS, PC A07/MF A01
4	6:17198	NTIS, PC A07/MF A01
4	6:17490	NTIS, PC A07/MF A01
DOE/EV/04361-		
T2	6:17600	NTIS, PC A02/MF A01
DOE/EV/04548-		
1	6:16498	NTIS, PC A03/MF A01
DOE/EV/04703-		
T1	6:17601	NTIS, PC A02/MF A01
DOE/EV/10024-		
1	6:16512	NTIS, PC A14/MF A01
DOE/EV/10268-		
1	6:17489	NTIS, PC A02/MF A01
DOE/EV/10281-		
T3	6:17448	NTIS, PC A09/MF A01
DOE/EV/24047-		
03	6:16499	NTIS, PC A99/MF A01
DOE/FE-		
0014	6:16920	NTIS, PC A03/MF A01
0015	6:16921	NTIS, PC A02/MF A01
DOE/GFETC/10059-		
2	6:16793	NTIS, PC A07/MF A01
DOE/ID/12079-		
21	6:16734	NTIS, PC A03/MF A01
23	6:16762	NTIS, PC A03/MF A01
24	6:16735	NTIS, PC A02/MF A01
25	6:17547	NTIS, PC A04/MF A01
26	6:17548	NTIS, PC A02/MF A01
29	6:16736	NTIS, PC A06/MF A01
DOE/IR/05106-		
1	6:16884	NTIS, PC A03/MF A01
DOE/IR/06355-		
T1	6:16404	NTIS, PC A09/MF A01
DOE/IR/10999-		
1	6:16981	NTIS, PC A04/MF A01
DOE/JPL/954331-		
81/ 13	6:16645	NTIS, PC A05/MF A01
DOE/JPL/954373-		
80/ 18	6:16646	NTIS, PC A03/MF A01
DOE/JPL/954852-		
7	6:16647	NTIS, PC A02/MF A01
DOE/JPL/955298-		
T1	6:16674	NTIS, PC A02/MF A01
DOE/LC/10049-		
T1	6:16529	NTIS, PC A05/MF A01
DOE/MC/08089-		
107	6:16516	NTIS, PC A04/MF A01
DOE/MC/08216-		
140	6:16517	NTIS, PC A03/MF A01
DOE/MC/10689-		
5	6:16488	NTIS, PC A03/MF A01
DOE/MC/11577-		
T9	6:16518	NTIS, PC A10/MF A01
DOE/MC/12186-		
126	6:16356	NTIS, PC A06/MF A01
DOE/MC/14522-		
1	6:16357	NTIS, PC A13/MF A01
1	6:16358	NTIS, PC A13/MF A01
1	6:16359	NTIS, PC A13/MF A01
1	6:16360	NTIS, PC A13/MF A01
1	6:16361	NTIS, PC A13/MF A01
1	6:16362	NTIS, PC A13/MF A01
1	6:16363	NTIS, PC A13/MF A01
1	6:16364	NTIS, PC A13/MF A01
1	6:16365	NTIS, PC A13/MF A01
1	6:16366	NTIS, PC A13/MF A01
1	6:16367	NTIS, PC A13/MF A01
DOE/METC-		
2287/ 112	6:16524	NTIS, PC A02/MF A01
DOE/METC/SP-		
111	6:16368	NTIS, PC A07/MF A01
125	6:16446	NTIS, PC A02/MF A01
129	6:16369	NTIS, PC A05/MF A01

Report No.	Abstract No.	Availability
DOE/NASA/51044-		
17	6:17069	NTIS, PC A03/MF A01
DOE/NDC-		
21/ L(Vol.1)	6:17273	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17274	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17681	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17682	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17683	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17684	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17690	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17691	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17692	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17693	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17694	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17695	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17696	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17700	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17702	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17703	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17707	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17712	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17718	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17725	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17731	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17732	NTIS, PC A19/MF A01
21/ L(Vol.1)	6:17737	NTIS, PC A19/MF A01
21/ L(Vol.2)	6:17275	NTIS, PC A20/MF A01
21/ L(Vol.2)	6:17685	NTIS, PC A20/MF A01
21/ L(Vol.2)	6:17704	NTIS, PC A20/MF A01
21/ L(Vol.2)	6:17713	NTIS, PC A20/MF A01
21/ L(Vol.2)	6:17726	NTIS, PC A20/MF A01
DOE/NV/00597-		
6	6:16554	NTIS, PC A04/MF A01
DOE/NWTS-		
33(2)	6:16560	NTIS, PC A04/MF A01
DOE/OR/13405-		
T1	6:16370	NTIS, PC A03/MF A01
DOE/PC/30013-		
3	6:16396	NTIS, PC A03/MF A01
DOE/PC/30088-		
4	6:16371	NTIS, PC A03/MF A01
DOE/PC/30214-		
T1	6:17240	NTIS, PC A02/MF A01
DOE/PC/30291-		
1	6:16372	NTIS, PC A02/MF A01
DOE/PE-		
0027(Add.)	6:16457	NTIS, PC A19/MF A01
DOE/PE/70044-		
T2	6:16960	NTIS, PC A08/MF A01
DOE/PE/70106-		
T5	6:16894	NTIS, PC A03/MF A01
DOE/PE/70151-		
T5	6:16648	NTIS, PC A07/MF A01
DOE/R5/10124-		
T1	6:16774	NTIS, PC A02/MF A01
DOE/R5/10134-		
1	6:16775	NTIS, PC A02/MF A01
DOE/R5/10151-		
1	6:17036	NTIS, PC A02/MF A01
DOE/R5/10213-		
1	6:16697	NTIS, PC A02/MF A01
DOE/R5/10215-		
1	6:16698	NTIS, PC A02/MF A01
DOE/R5/10235-		
1	6:16709	NTIS, PC A02/MF A01
DOE/R5/10246-		
1	6:16699	NTIS, PC A04/MF A01
DOE/R9/10031-		
T1	6:16617	NTIS, PC A06/MF A01
DOE/RA-		
0047/ 1	6:16505	NTIS, PC A04/MF A01
DOE/RG-		
0057	6:16913	NTIS, PC A03/MF A01
DOE/RG/10333-		
T1	6:16922	NTIS, PC A02/MF A01
DOE/RG/10367-		
T2	6:16914	NTIS, PC A02/MF A01
DOE/SEA-		
1109-20401/ 81/ 1	6:16770	NTIS, PC A07/MF A01
1109-20401/ 81/ 2	6:16776	NTIS, PC A06/MF A01
7315-2074/ 81/ 2	6:16777	NTIS, PC A05/MF A01
7315-20741/ 81/ 1	6:16778	NTIS, PC A04/MF A01
DOE/SF/01910-		
T2	6:16980	NTIS, PC A02/MF A01
DOE/SF/01963-		
T1	6:16903	NTIS, PC A03/MF A01

Report No.	Abstract No.	Availability
T2	6:16779	NTIS, PC A04/MF A01
T3	6:16885	NTIS, PC A02/MF A01
DOE/SF/01973-		
T1	6:16700	NTIS, PC A13/MF A01
DOE/SF/02034-		
T10	6:16834	NTIS, PC A16/MF A01
DOE/SF/10840-		
T1	6:16961	NTIS, PC A05/MF A01
DOE/TIC-		
11435(Vol.1)	6:17834	NTIS, PC A03/MF A01
11435(Vol.2)	6:17835	NTIS, PC A06/MF A01
11436	6:16962	NTIS, PC A03/MF A01
11438	6:16907	Washington, DC; Brookings Institution (1981).
11441	6:16454	NTIS, PC A02/MF A01
11444	6:16427	NTIS, PC A03/MF A01
11445	6:16428	NTIS, PC A03/MF A01
DP-		
1583	6:17383	NTIS, PC A02/MF A01
1592	6:17440	NTIS, PC A02/MF A01
DP-MS-		
80-105	6:17326	NTIS, PC A02/MF A01
80-131	6:17543	NTIS, PC A02/MF A01
EEB-Vent-		
81-4	6:17356	*See* LBL-12199
EGG/GEND-		
003	6:16870	NTIS, PC A04/MF A01
EGG-PHYS-		
5392	6:17836	NTIS, PC A03/MF A01
EGG-WM-		
5393	6:16576	NTIS, PC A02/MF A01
EMD-		
2-67-3319	6:16381	*See* NP-25377
2-68-3304	6:16489	*See* NP-25370
76-263	6:16741	*See* NP-25336
78-2120	6:16740	*See* NP-25335
ENDF-		
307	6:17734	*See* ORNL/TM-7661
EPRI-AP-		
1681(Vol.1)	6:16786	NTIS, PC A16/MF A01
1725	6:16373	NTIS, PC A09/MF A01
1740(Vol.1)	6:16374	NTIS, PC A06/MF A01
EPRI-CS-		
1579(Vol.3) (Add.)	6:16405	NTIS, PC A03/MF A01
1622	6:16447	NTIS, PC A17/MF A01
1677	6:16794	NTIS, PC A10/MF A01
1683-SY	6:17351	NTIS, PC A02/MF A01
1695	6:16455	NTIS, PC A03/MF A01
1736(Vol.1)	6:16795	NTIS, PC A08/MF A01
1736(Vol.2)	6:16406	NTIS, PC A14/MF A01
1738	6:16407	NTIS, PC A04/MF A01
1739	6:17352	NTIS, PC A07/MF A01
EPRI-EA-		
673(Vol.2Pt.2)	6:16419	NTIS, PC A23/MF A01
673(Vol.2Pt.3)	6:16420	NTIS, PC A21/MF A01
1724	6:16886	NTIS, PC A07/MF A01
1746	6:16458	NTIS, PC A04/MF A01
EPRI-EL-		
851(Vol.2)	6:16808	NTIS, PC A07/MF A01
1424(Vol.2)	6:16787	NTIS, PC A22/MF A01
1737	6:16809	NTIS, PC A03/MF A01
1745	6:16810	NTIS, PC A08/MF A01
1756	6:16811	NTIS, PC A06/MF A01
1758	6:16910	NTIS, PC A04/MF A01
EPRI-EM-		
1664	6:16950	NTIS, PC A04/MF A01
1699	6:16951	NTIS, PC A03/MF A01
1711	6:16952	NTIS, PC A04/MF A01
1717	6:16788	NTIS, PC A07/MF A01
EPRI-NP-		
1734	6:16849	NTIS, PC A10/MF A01
1747	6:16871	NTIS, PC A10/MF A01
1763	6:17733	NTIS
EPRI-WS-		
79-192	6:16881	NTIS, PC A04/MF A01
80-119	6:16448	NTIS, PC A13/MF A01
ESL-		
48	6:16734	*See* DOE/ID/12079-21
50	6:16735	*See* DOE/ID/12079-24
54	6:16736	*See* DOE/ID/12079-29
EUR-		
6769-EN	6:16891	European Community Information Service, Washington, DC
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FE-		
1231-25	6:16411	NTIS, PC A06/MF A01
2777-16	6:16350	*See* DOE/ET/13005-T2
2806-16	6:16375	NTIS, PC A06/MF A01
2806-16	6:16376	NTIS, PC A06/MF A01
FERC-		
0050	6:16928	NTIS, PC A07/MF A01
0052	6:16929	NTIS, PC A11/MF A01
0053	6:16930	NTIS, PC A08/MF A01
0054	6:16931	NTIS, PC A11/MF A01
0066	6:16618	NTIS, PC A05/MF A01
0072	6:16619	NTIS, PC A03/MF A01
0073	6:16620	NTIS, PC A02/MF A01
0074	6:16621	NTIS, PC A02/MF A01
0075	6:16622	NTIS, PC A02/MF A01
0076	6:16623	NTIS, PC A02/MF A01
0077	6:16624	NTIS, PC A02/MF A01
0078	6:16625	NTIS, PC A02/MF A01
0079	6:16626	NTIS, PC A02/MF A01
FERMILAB-CONF-		
80/ 79-THY	6:17677	NTIS, PC A08/MF A01
80/ 86-THY	6:17656	NTIS, PC A04/MF A01
FOA-C-		
20295-E4	6:17549	NTIS (US Sales Only), PC A03/ MF A01
GA-A-		
15406(add.)	6:16838	NTIS, PC A02/MF A01
16098	6:17837	NTIS, PC A23/MF A01
16194	6:17761	NTIS, PC A02/MF A01
16217	6:16835	NTIS, PC A09/MF A01
16283	6:16836	NTIS, PC A02/MF A01
GEAP-		
24310	6:16829	NTIS, PC A06/MF A01
GEFR-SP-		
146	6:16839	NTIS, PC A03/MF A01
148	6:16840	NTIS, PC A03/MF A01
GEPP-OP-		
563	6:17234	NTIS, PC A03/MF A01
GJBX-		
2(81)	6:16533	NTIS, PC A14/MF A01
3(81)	6:16531	NTIS, PC A17/MF A01
9(81)	6:16534	NTIS, PC A05/MF A01
29-80(Pt.6)	6:16535	NTIS, PC E09/MF, $3.50
29(80) (Pt.7)	6:16536	NITS, PC E10/MF, $3.50
38(81)	6:16537	NTIS, PC A02/MF A01
77(81)	6:16538	NTIS, PC E08/MF, $3.50
82(81)	6:16539	NTIS, PC E07/MF, $4.10
83(81)	6:16540	NTIS, PC E07/MF, $4.10
84(81)	6:16541	NTIS, PC E07/MF, $4.10
85(81)	6:16542	NTIS, PC E08/MF, $4.10
86(81)	6:16543	NTIS, PC E10/MF, $4.20
87(81)	6:16544	NTIS, PC E09/MF, $4.10
95(81)	6:16545	NTIS, PC E09/MF, $3.65
96(81)	6:16546	NTIS, PC E09/MF, $3.65
97(81)	6:16547	NTIS, PC E10/MF, $3.65
99(81)	6:16548	NTIS, PC A02/MF A01
GJO-		
112(81)	6:16532	NTIS, PC A02/MF A01
HEDL-SA-		
1936	6:17100	NTIS, PC A02/MF A01
1985	6:16857	NTIS, PC A02/MF A01
2116	6:16841	NTIS, PC A02/MF A01
2121-FP	6:16872	NTIS, PC A02/MF A01
2122-FP	6:17327	NTIS, PC A02/MF A01
2191	6:17206	NTIS, PC A02/MF A01
2200	6:16842	NTIS, PC A02/MF A01
HEDL-TME-		
81-4	6:16843	NTIS, PC A05/MF A01
HNEI-		
80-07	6:16932	Hawaii Natural Energy Institute, Honolulu, Hawaii
INDC(USA)-		
84/ L(Vol.1)	6:17273	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17274	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17681	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17682	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17683	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17684	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17690	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17691	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17692	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17693	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17694	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17695	*See* DOE/NDC-21/L(Vol.1)

Report No.	Abstract No.	Availability
84/ L(Vol.1)	6:17696	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17700	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17702	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17703	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17707	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17712	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17718	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17725	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17731	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17732	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.1)	6:17737	*See* DOE/NDC-21/L(Vol.1)
84/ L(Vol.2)	6:17275	*See* DOE/NDC-21/L(Vol.2)
84/ L(Vol.2)	6:17685	*See* DOE/NDC-21/L(Vol.2)
84/ L(Vol.2)	6:17704	*See* DOE/NDC-21/L(Vol.2)
84/ L(Vol.2)	6:17713	*See* DOE/NDC-21/L(Vol.2)
84/ L(Vol.2)	6:17726	*See* DOE/NDC-21/L(Vol.2)
INIS-mf-		
6088	6:17708	NTIS (US Sales Only), PC A10/ MF A01
6088	6:17738	NTIS (US Sales Only), PC A10/ MF A01
INKA-Conf-		
79-001-000	6:17697	Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany, F.R.
79-001-000	6:17719	Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, Germany, F.R.
79-001-017	6:17719	*See* INKA-Conf-79-001-000
79-001-021	6:17697	*See* INKA-Conf-79-001-000
IS-T-		
911	6:17166	NTIS, PC A06/MF A01
929	6:17657	NTIS, PC A04/MF A01
948	6:16397	NTIS, PC A05/MF A01
IS-Trans-		
111	6:17167	NTIS, PC A02/MF A01
ISU-ERI-AMES-		
81402	6:16370	*See* DOE/OR/13405-T1
JHU/APL-SR-		
80-1A	6:16684	NTIS, PC A12/MF A01
80-1B	6:16685	NTIS, PC A06/MF A01
JPL-PUB-		
80-94	6:17068	*See* DOE/CS/54209-T1
JPRS-		
77198	6:16895	NTIS
77389	6:17559	NTIS
77393	6:17540	NTIS
JUEL-		
1648	6:16600	NTIS (US Sales Only), PC A05/ MF A01
Juel-Spez-		
52	6:17101	NTIS (US Sales Only), PC A05/ MF A01
K/CSD/TM-		
36	6:16549	NTIS, PC A04/MF A01
K/OA-		
4955	6:16584	NTIS, PC A03/MF A01
K/UR-		
29(Pt.6)	6:16535	*See* GJBX-29-80(Pt.6)
29(Pt.7)	6:16536	*See* GJBX-29(80)(Pt.7)
145	6:16538	*See* GJBX-77(81)
KAPL-		
4139	6:17227	NTIS, PC A02/MF A01
LA-		
8161-M	6:17763	NTIS, PC A07/MF A01
8425-MS	6:17764	NTIS, PC A02/MF A01
8606-PR	6:16812	NTIS, PC A02/MF A01
8669-MS	6:17208	NTIS, PC A02/MF A01
8676-T	6:16737	NTIS, PC A11/MF A01
8691-PR	6:16578	NTIS, PC A02/MF A01
8710-HDR	6:16738	NTIS, PC A03/MF A01
8729-MS	6:17765	NTIS, PC A04/MF A01
8738-MS	6:17766	NTIS, PC A02/MF A01
8742-PR	6:16844	NTIS, PC A02/MF A01
LA-tr-		
80-42	6:17276	NTIS, PC A02/MF A01
80-43	6:17284	NTIS, PC A04/MF A01
LA-UR-		
80-3052	6:17353	NTIS, PC A02/MF A01
81-679	6:17328	NTIS, PC A02/MF A01
81-681	6:16873	NTIS, PC A02
81-682	6:17767	NTIS, PC A02/MF A01
81-703	6:16859	NTIS, PC A02/MF A01
81-729	6:17354	NTIS, PC A02/MF A01
81-730	6:17257	NTIS, PC A02/MF A01
81-731	6:17277	NTIS, PC A02/MF A01
81-735	6:16507	NTIS, PC A02/MF A01
81-736	6:16508	NTIS, PC A02/MF A01
81-737	6:17258	NTIS, PC A02/MF A01
81-746	6:17278	NTIS, PC A02/MF A01
81-747	6:17102	NTIS, PC A02/MF A01
81-748	6:17511	NTIS, PC A02/MF A01
81-764	6:16378	NTIS, PC A02/MF A01
81-772	6:17279	NTIS, PC A02/MF A01
81-781	6:17299	NTIS, PC A02/MF A01
81-783	6:17280	NTIS, PC A02/MF A01
81-784	6:17259	NTIS, PC A02/MF A01
81-805	6:17281	NTIS, PC A02/MF A01
81-818	6:17249	NTIS, PC A02/MF A01
81-830	6:16561	NTIS, PC A02/MF A01
81-831	6:17209	NTIS, PC A02/MF A01
81-870	6:17565	NTIS, PC A02/MF A01
81-896	6:17768	NTIS, PC A03/MF A01
81-898	6:17157	NTIS, PC A03/MF A01
81-994	6:17755	NTIS, PC A03/MF A01
81-1021	6:17142	NTIS, PC A02/MF A01
81-1023	6:16712	NTIS, PC A02/MF A01
81-1024	6:17897	NTIS, PC A02/MF A01
LAPS-		
71	6:17769	NTIS, PC A03/MF A01
LBL-		
10639	6:17103	NTIS, PC A04/MF A01
10757	6:17260	NTIS, PC A02/MF A01
11650	6:16525	NTIS, PC A19/MF A01
11650	6:16615	NTIS, PC A19/MF A01
11650	6:16627	NTIS, PC A19/MF A01
11650	6:16887	NTIS, PC A19/MF A01
11650	6:16963	NTIS, PC A19/MF A01
11650	6:17202	NTIS, PC A19/MF A01
11650	6:17329	NTIS, PC A19/MF A01
11650	6:17355	NTIS, PC A19/MF A01
11652	6:17743	NTIS, PC A03/MF A01
11858	6:17491	NTIS, PC A02/MF A01
11972	6:16888	NTIS, PC A06/MF A01
11972	6:16889	NTIS, PC A06/MF A01
11972	6:16904	NTIS, PC A06/MF A01
11972	6:16905	NTIS, PC A06/MF A01
12012	6:16739	NTIS, PC A06/MF A01
12152	6:16379	NTIS, PC A03/MF A01
12199	6:17356	NTIS, PC A05/MF A01
12220	6:16753	NTIS, PC A02/MF A01
12275	6:17631	NTIS, PC A03/MF A01
12280	6:16964	NTIS, PC A02/MF A01
12308	6:16380	NTIS, PC A03/MF A01
12328	6:16686	NTIS, PC A10/MF A01
12331	6:16606	NTIS, PC A02/MF A01
12356	6:16763	NTIS, PC A12/MF A01
12431	6:17430	NTIS, PC A02/MF A01
LMF-		
77	6:17533	NTIS, PC A03/MF A01
82	6:17452	NTIS, PC A04/MF A01
MAI-		
201	6:16692	*See* ANL-K-80-68
204	6:16690	*See* ANL-K-80-53
206	6:16691	*See* ANL-K-80-59
MCR-		
78-1325	6:16677	NTIS, PC A02/MF A01
79-1311	6:16678	NTIS, PC A02/MF A01
MDC-G-		
8656ES	6:16701	NTIS, PC A03/MF A01
MHSMP-		
81-08	6:17336	NTIS, PC A02/MF A01
81-09	6:17337	NTIS, PC A02/MF A01
81-10	6:17338	NTIS, PC A02/MF A01
MIT-EL-		
80-006	6:16867	*See* DOE/ET/37218-2
80-010	6:16868	*See* DOE/ET/37218-3
MLM-		
2809	6:16589	NTIS, PC A03/MF A01
2811	6:17339	NTIS, PC A02/MF A01
2815(OP)	6:17168	NTIS, PC A02/MF A01
2816(OP)	6:16550	NTIS, PC A02/MF A01
2822	6:17441	NTIS, PC A03/MF A01
MLM-EGSP-TPR-Q-		
016	6:16509	*See* MLM-MU-81-53-0002
MLM-MU-		
81-53-0002	6:16509	NTIS, PC A13/MF A01
MTR-		
80W326	6:16347	*See* DOE/ET/10280-T1
NASA-TM-		
81718	6:17069	*See* DOE/NASA/51044-17
NBS-TN-		
1131	6:16965	GPO$3.75

Report No.	Abstract No.	Availability
NDRL-		
2210	6:17189	*See* DOE/ER/00038-2210
NE-E-		
15-2NC-T(1-81)	6:16850	NTIS, PC A03/MF A01
NE-F-		
3-6T(Rev.) (3-81)	6:16848	Nuclear Standards Management Center, Oak Ridge, TN
NE-M-		
7-7T(Rev.) (1-81)	6:17114	Nuclear Standards Management Center, Oak Ridge, TN
NEANDC(US)-		
208/ L(Vol.1)	6:17273	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17274	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17681	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17682	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17683	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17684	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17690	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17691	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17692	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17693	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17694	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17695	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17696	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17700	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17702	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17703	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17707	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17712	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17718	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17725	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17731	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17732	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.1)	6:17737	*See* DOE/NDC-21/L(Vol.1)
208/ L(Vol.2)	6:17275	*See* DOE/NDC-21/L(Vol.2)
208/ L(Vol.2)	6:17685	*See* DOE/NDC-21/L(Vol.2)
208/ L(Vol.2)	6:17704	*See* DOE/NDC-21/L(Vol.2)
208/ L(Vol.2)	6:17713	*See* DOE/NDC-21/L(Vol.2)
208/ L(Vol.2)	6:17726	*See* DOE/NDC-21/L(Vol.2)
NMAB-		
363	6:16459	National Academy of Sciences, Office of Publications, Washington, DC
NP-		
22593	6:16933	EPRI, Palo Alto, CA
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NVO-		
230	6:16742	NTIS, PC A04/MF A01
NYSERDA-		
80-23	6:16456	New York State Energy Research and Development Authority, Albany
NZERDC-		
55	6:16761	NTIS (US Sales Only), PC A03/ MF A01
ONWI-		
104	6:17552	NTIS, PC A12/MF A01
138	6:16562	NTIS, PC A03/MF A01
222	6:16563	NTIS, PC A05/MF A01

Report No.	Abstract No.	Availability
ORAU/IEA-		
25(1980)	6:16915	NTIS, PC A03/MF A01
ORNL-		
5601	6:16579	NTIS, PC A08/MF A01
5602	6:17435	NTIS, PC E04/MF, $3.50
5611	6:17431	NTIS, PC A05/MF A01
5690	6:16845	NTIS, PC A04/MF A01
5747	6:17169	NTIS, PC A08/MF A01
5754	6:16890	NTIS, PC A04/MF A01
5756	6:16846	NTIS, PC A06/MF A01
ORNL/CON-		
40	6:16911	NTIS, PC A04/MF A01
ORNL/CSD/TM-		
145	6:16880	NTIS, PC A02/MF A01
ORNL/MIT-		
321	6:16382	NTIS, PC A04/MF A01
324	6:16564	NTIS, PC A04/MF A01
ORNL/Sub-		
7676/ 1	6:17770	NTIS, PC A06/MF A01
7685/ 1	6:16383	NTIS, PC A05/MF A01
7715/ 2	6:16966	NTIS, PC A05/MF A01
ORNL/TM-		
7132	6:17771	NTIS, PC A04/MF A01
7289	6:17544	NTIS, PC A03/MF A01
7412	6:16855	NTIS, PC A06/MF A01
7415	6:17744	NTIS, PC A03/MF A01
7561	6:16601	NTIS, PC A03/MF A01
7581	6:16384	NTIS, PC A09/MF A01
7605	6:17199	NTIS, PC A02/MF A01
7608	6:17158	NTIS, PC A02/MF A01
7616	6:17772	NTIS, PC A04/MF A01
7629	6:16967	NTIS, PC A04/MF A01
7644	6:17425	NTIS, PC A04/MF A01
7654	6:17432	NTIS, PC A03/MF A01
7661	6:17734	NTIS, PC A04/MF A01
7675	6:17773	NTIS, PC A05/MF A01
7691	6:17838	NTIS, PC A03/MF A01
7695	6:17553	NTIS, PC A07/MF A01
7732	6:17735	NTIS, PC A02/MF A01
7754	6:16858	NTIS, PC A02/MF A01
7758	6:17839	NTIS, PC A02/MF A01
7786	6:17686	NTIS, PC A02/MF A01
ORNL-tr-		
4725	6:16401	NTIS, PC A02/MF A01
4734	6:16551	NTIS, PC A02/MF A01
4734	6:16551	NTIS, PC A02/MF A01
4739	6:16575	NTIS, PC A03/MF A01
4740	6:16558	NTIS, PC A03/MF A01
ORO-		
3602-21	6:17200	NTIS, PC A02/MF A01
OTA-E-		
128	6:16650	GPO
P-		
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A 163,897	6:17322	
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4,226,369	6:16791	
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Report No.	Abstract No.	Availability
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PB-		
80-205024	6:17387	NTIS, PC A06/MF A01
80-205610	6:17357	NTIS, PC A03/MF A01
80-205792	6:17384	NTIS, PC A06/MF A01
80-206980	6:17388	NTIS, PC A19/MF A01
80-207541	6:16429	NTIS, PC A09/MF A01
80-207939	6:16652	NTIS, PC A06/MF A01
80-207970	6:17203	NTIS, PC A04/MF A01
80-207988	6:16461	NTIS, PC A03/MF A01
80-208218	6:16982	NTIS, PC A03/MF A01
80-208648	6:16916	NTIS, PC A05/MF A01
80-208978	6:16935	NTIS, PC A04/MF A01
80-209190	6:16923	NTIS, PC A06/MF A01
80-209778	6:17358	NTIS, PC A02/MF A01
80-209877	6:17075	NTIS, PC A04/MF A01
80-209927	6:17058	NTIS, PC A02/MF A01
80-209976	6:17523	NTIS, PC A14/MF A01
80-210180	6:16898	NTIS, PC A03/MF A01
80-210222	6:16430	NTIS, PC A03/MF A01
80-210271	6:16503	NTIS, PC A16/MF A01
80-210289	6:16492	NTIS, PC A15/MF A01
80-210297	6:16493	NTIS, PC A20/MF A01
80-210305	6:17059	NTIS, PC A02/MF A01
80-210453	6:17060	NTIS, PC A02/MF A01
80-210529	6:16385	NTIS, PC A05/MF A01
80-210552	6:17534	NTIS, PC A03/MF A01
80-210685	6:16521	NTIS, PC A05/MF A01
80-210701	6:16514	NTIS, PC A13/MF A01
80-210719	6:16970	NTIS, PC A05/MF A01
80-210727	6:16971	NTIS, PC A04/MF A01
80-210735	6:16972	NTIS, PC A03/MF A01
80-210743	6:17037	NTIS, PC A05/MF A01
80-210750	6:16522	NTIS, PC A04/MF A01
80-210768	6:16523	NTIS, PC A07/MF A01
80-210776	6:16594	NTIS, PC A09/MF A01
80-210800	6:17359	NTIS, PC A08/MF A01
80-211113	6:16408	NTIS, PC A15/MF A01
80-211121	6:16409	NTIS, PC A17/MF A01
80-211212	6:17539	NTIS, PC A05/MF A01
80-211386	6:17243	NTIS, PC A10/MF A01
80-211832	6:16796	NTIS, PC A12/MF A01
80-212020	6:17070	NTIS, PC A09/MF A01
80-212111	6:17389	NTIS, PC A18/MF A01
80-212129	6:17360	NTIS, PC A17/MF A01
80-212202	6:17104	NTIS, PC A08/MF A01
80-212236	6:16616	NTIS, PC A05/MF A01
80-212467	6:16494	NTIS, PC A17/MF A01
80-212475	6:16495	NTIS, PC A23/MF A01
80-212483	6:17904	NTIS, PC A12/MF A01
80-212624	6:16496	NTIS, PC A99/MF A01
80-212723	6:16924	NTIS, PC A07/MF A01
80-212764	6:16789	NTIS, PC A03/MF A01
80-212780	6:17390	NTIS, PC A04/MF A01
80-212798	6:17391	NTIS, PC A08/MF A01
80-212939	6:17244	NTIS, PC A10/MF A01
80-213002	6:17728	NTIS, PC A03/MF A01
80-213036	6:16797	NTIS, PC A10/MF A01
80-213119	6:17361	NTIS, PC A10/MF A01
80-213424	6:16973	NTIS, PC A06/MF A01
80-213986	6:16974	NTIS, PC A07/MF A01
80-214273	6:16936	NTIS, PC A06/MF A01
80-215692	6:16653	NTIS, PC A08/MF A01
80-215734	6:17245	NTIS, PC A06/MF A01
80-216757	6:17436	NTIS, PC A10/MF A01
80-219249	6:16798	NTIS, PC A09/MF A01
80-219256	6:16799	NTIS, PC A11/MF A01
80-219264	6:16504	NTIS, PC A20/MF A01
80-219272	6:16431	NTIS, PC A05/MF A01
80-219280	6:16412	NTIS, PC A11/MF A01
80-219330	6:16413	NTIS, PC A99/MF A01
80-219413	6:17344	NTIS, PC A04/MF A01
80-219421	6:17362	NTIS, PC A11/MF A01
80-219454	6:16432	NTIS, PC A04/MF A01
80-219462	6:16433	NTIS, PC A10/MF A01
80-219512	6:17246	NTIS, PC A08/MF A01
80-219520	6:17247	NTIS, PC A09/MF A01
80-219546	6:17363	NTIS, PC A99/MF A01
80-219553	6:17364	NTIS, PC A18/MF A01
80-219561	6:17365	NTIS, PC A17/MF A01
80-219587	6:17248	NTIS, PC A03/MF A01
80-219603	6:16925	NTIS, PC A06/MF A01
80-219728	6:16983	NTIS, PC A05/MF A01
80-220320	6:17366	NTIS, PC A12/MF A01
80-220502	6:16414	NTIS, PC A06/MF A01
80-220593	6:16501	NTIS, PC A03/MF A01
80-220627	6:16800	NTIS, PC A09/MF A01
80-220635	6:16415	NTIS, PC A08/MF A01
80-220734	6:17392	NTIS, PC A07/MF A01
80-220759	6:17061	NTIS, PC A15/MF A01
80-220775	6:16398	NTIS, PC A08/MF A01
80-220833	6:17367	Source tape is in EBCDIC character set. Tapes can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, track, density, and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB-80-220841. Also available as punched cards
80-220841	6:17368	NTIS, PC A09/MF A01
80-220957	6:16801	NTIS, PC A19/MF A01
80-221039	6:16502	NTIS, PC A05/MF A01
80-221062	6:16416	NTIS, PC A09/MF A01
80-221229	6:17393	NTIS, PC A05/MF A01
80-221237	6:17369	NTIS, PC A06/MF A01
80-221260	6:17394	NTIS, PC A99/MF A01
80-221674	6:17370	NTIS, PC A04/MF A01
80-221708	6:17371	NTIS, PC A03/MF A01
80-222409	6:16410	NTIS, PC A12/MF A01
80-222433	6:17905	NTIS, PC A13/MF A01
80-222474	6:16813	NTIS, PC A02/MF A01
80-222482	6:16497	NTIS, PC A09/MF A01
80-222516	6:16702	NTIS, PC A03/MF A01
80-222532	6:17372	NTIS, PC A19/MF A01
80-222565	6:16449	NTIS, PC A02/MF A01
80-222573	6:16450	NTIS, PC A19/MF A01
80-222631	6:16790	NTIS, PC A03/MF A01
80-222714	6:16975	NTIS, PC A09/MF A01
80-223126	6:16530	NTIS, PC A07/MF A01
80-223514	6:17373	NTIS, PC A02/MF A01
80-223647	6:16917	NTIS, PC A11/MF A01
80-224256	6:17062	NTIS, PC A03/MF A01
80-813389	6:16953	NTIS PCN01/MF N01
80-813397	6:16954	NTIS PCN01/MF N01
80-813462	6:17374	NTIS PCN01/MF N01
80-813470	6:17375	NTIS PCN01/MF N01
80-813553	6:16595	NTIS PCN01/MF N01
80-813785	6:16908	NTIS PCN01/MF N01
80-813793	6:16909	NTIS PCN01/MF N01
80-813934	6:16713	NTIS PCN01/MF N01
80-814122	6:16714	NTIS PCN01/MF N01
80-814130	6:16715	NTIS PCN01/MF N01
80-814478	6:17376	NTIS PCN01/MF N01
80-814809	6:17437	NTIS PCN01/MF N01
80-815210	6:17105	NTIS PCN01/MF N01
80-815244	6:17106	NTIS PCN01/MF N01
PNL-		
1845-49	6:16591	NTIS, PC A02/MF A01
2990	6:16565	NTIS, PC A06/MF A01
3090	6:16566	NTIS, PC A04/MF A01
3195-WERA-2	6:16767	NTIS, PC A09/MF A01
3195-WERA-3	6:16768	NTIS, PC A09/MF A01
3195-WERA-10	6:16769	NTIS, PC A09/MF A01
3409	6:17524	NTIS, PC A03/MF A01
3414	6:16580	NTIS, PC A04/MF A01
3536	6:17305	NTIS, PC A13/MF A01
3536	6:17306	NTIS, PC A13/MF A01
3536	6:17307	NTIS, PC A13/MF A01
3536	6:17308	NTIS, PC A13/MF A01
3536	6:17309	NTIS, PC A13/MF A01
3536	6:17310	NTIS, PC A13/MF A01
3536	6:17311	NTIS, PC A13/MF A01
3536	6:17312	NTIS, PC A13/MF A01
3536	6:17313	NTIS, PC A13/MF A01
3536	6:17314	NTIS, PC A13/MF A01
3536	6:17315	NTIS, PC A13/MF A01
3566	6:16555	NTIS, PC A06/MF A01
3605	6:16976	NTIS, PC A05/MF A01
3685	6:17840	NTIS, PC A05/MF A01
3695	6:16654	NTIS, PC A08/MF A01
3700(Pt.5)	6:17377	NTIS, PC A05/MF A01

Report No.	Abstract No.	Availability
3700(Pt.5)	6:17385	NTIS, PC A05/MF A01
3700(Pt.5)	6:17421	NTIS, PC A05/MF A01
3700(Pt.5)	6:17438	NTIS, PC A05/MF A01
3700(Pt.5)	6:17446	NTIS, PC A05/MF A01
3700(Pt.5)	6:17453	NTIS, PC A05/MF A01
3700(Pt.5)	6:17454	NTIS, PC A05/MF A01
3700(Pt.5)	6:17455	NTIS, PC A05/MF A01
3700(Pt.5)	6:17456	NTIS, PC A05/MF A01
3700(Pt.5)	6:17457	NTIS, PC A05/MF A01
3700(Pt.5)	6:17458	NTIS, PC A05/MF A01
3700(Pt.5)	6:17459	NTIS, PC A05/MF A01
3700(Pt.5)	6:17460	NTIS, PC A05/MF A01
3700(Pt.5)	6:17461	NTIS, PC A05/MF A01
3700(Pt.5)	6:17462	NTIS, PC A05/MF A01
3700(Pt.5)	6:17506	NTIS, PC A05/MF A01
3700(Pt.5)	6:17507	NTIS, PC A05/MF A01
3700(Pt.5)	6:17508	NTIS, PC A05/MF A01
3700(Pt.5)	6:17509	NTIS, PC A05/MF A01
3700(Pt.5)	6:17510	NTIS, PC A05/MF A01
3703	6:16780	NTIS, PC A08/MF A01
3710	6:16655	NTIS, PC A07/MF A01
PNL-SA-		
9054	6:16567	NTIS, PC A02/MF A01
PNL-TR-		
410	6:16573	NTIS, PC A03/MF A01
PPPL-		
1729	6:17774	NTIS, PC A02/MF A01
1755	6:17775	NTIS, PC A11/MF A01
1755	6:17776	NTIS, PC A11/MF A01
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1755	6:17783	NTIS, PC A11/MF A01
1755	6:17784	NTIS, PC A11/MF A01
1755	6:17785	NTIS, PC A11/MF A01
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1755	6:17788	NTIS, PC A11/MF A01
1755	6:17789	NTIS, PC A11/MF A01
1755	6:17790	NTIS, PC A11/MF A01
1755	6:17791	NTIS, PC A11/MF A01
1755	6:17792	NTIS, PC A11/MF A01
1755	6:17793	NTIS, PC A11/MF A01
1755	6:17794	NTIS, PC A11/MF A01
1755	6:17795	NTIS, PC A11/MF A01
1755	6:17841	NTIS, PC A11/MF A01
1755	6:17842	NTIS, PC A11/MF A01
1755	6:17843	NTIS, PC A11/MF A01
1755	6:17844	NTIS, PC A11/MF A01
1755	6:17845	NTIS, PC A11/MF A01
1755	6:17846	NTIS, PC A11/MF A01
1755	6:17847	NTIS, PC A11/MF A01
1755	6:17848	NTIS, PC A11/MF A01
1755	6:17849	NTIS, PC A11/MF A01
1755	6:17850	NTIS, PC A11/MF A01
1755	6:17851	NTIS, PC A11/MF A01
1755	6:17852	NTIS, PC A11/MF A01
1755	6:17853	NTIS, PC A11/MF A01
1755	6:17854	NTIS, PC A11/MF A01
1755	6:17855	NTIS, PC A11/MF A01
1755	6:17856	NTIS, PC A11/MF A01
1755	6:17857	NTIS, PC A11/MF A01
1755	6:17858	NTIS, PC A11/MF A01
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1755	6:17860	NTIS, PC A11/MF A01
1755	6:17861	NTIS, PC A11/MF A01
1755	6:17862	NTIS, PC A11/MF A01
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1755	6:17864	NTIS, PC A11/MF A01
1755	6:17865	NTIS, PC A11/MF A01
1755	6:17866	NTIS, PC A11/MF A01
1755	6:17867	NTIS, PC A11/MF A01
1755	6:17868	NTIS, PC A11/MF A01
1755	6:17869	NTIS, PC A11/MF A01
1755	6:17870	NTIS, PC A11/MF A01
1755	6:17871	NTIS, PC A11/MF A01
1755	6:17872	NTIS, PC A11/MF A01
1755	6:17873	NTIS, PC A11/MF A01
1755	6:17874	NTIS, PC A11/MF A01
1755	6:17875	NTIS, PC A11/MF A01
1755	6:17876	NTIS, PC A11/MF A01
1755	6:17877	NTIS, PC A11/MF A01
1755	6:17878	NTIS, PC A11/MF A01
1755	6:17879	NTIS, PC A11/MF A01
1766	6:17796	NTIS, PC A02/MF A01
1768	6:17797	NTIS, PC A03/MF A01
1776	6:17798	NTIS, PC A02/MF A01
PPPL-Q-		
37	6:17880	NTIS, PC A05/MF A01
PRI-		
23	6:17799	*See* SAI-254-81-102-LJ
RAND/R-		
2515-DOE	6:16977	NTIS, PC A05/MF A01
RFP-		
3195	6:17107	NTIS, PC A02/MF A01
3198	6:17228	NTIS, PC A02/MF A01
RHO-BWI-		
80-100-4Q	6:16568	NTIS, PC A07/MF A01
RHO-BWI-C-		
87	6:17545	NTIS, PC A05/MF A01
RHO-BWI-CD-		
38(Rev.3)	6:16569	NTIS, PC A08/MF A01
RHO-LD-		
153	6:16570	NTIS, PC A04/MF A01
SAE/SP-		
80/ 452	6:17074	Warrendale, PA; Society of Automotive Engineers, Inc. (1980).
SAI-		
023-81-110LJ	6:17769	*See* LAPS-71
254-81-102-LJ	6:17799	NTIS, PC A04/MF A01
SAND-		
79-1592C	6:16754	NTIS, PC A03/MF A01
79-7117	6:16755	NTIS, PC A04/MF A01
79-8194(Vol.2) (App.)	6:16683	NTIS, PC A14/MF A01
80-0135	6:17211	NTIS, PC A14/MF A01
80-0410	6:16756	NTIS, PC A03/MF A01
80-1694	6:17341	NTIS, PC A04/MF A01
80-1959	6:16728	NTIS, PC A04/MF A01
80-1964/ 10	6:16716	NTIS, PC A02/MF A01
80-2012	6:16556	NTIS, PC A07/MF A01
80-2124	6:16557	NTIS, PC A04/MF A01
80-2192	6:17143	NTIS, PC A03/MF A01
80-2219C	6:16519	NTIS, PC A02/MF A01
80-2307C	6:16520	NTIS, PC A02/MF A01
80-2378	6:16679	NTIS, PC A08/MF A01
80-2431C	6:17108	NTIS, PC A02/MF A01
80-2504C	6:16717	NTIS, PC A02/MF A01
80-2573	6:17442	NTIS, PC A03/MF A01
80-2579	6:16386	NTIS, PC A02/MF A01
80-2613C	6:17124	NTIS, PC A03/MF A01
80-2646	6:16781	NTIS, PC A04/MF A01
80-2664	6:16387	NTIS, PC A03/MF A01
80-2669C	6:16782	NTIS, PC A02/MF A01
80-2685C	6:17881	NTIS, PC A02/MF A01
80-2878	6:16388	NTIS, PC A03/MF A01
80-7076	6:16718	NTIS, PC A03/MF A01
80-7136	6:16757	NTIS, PC A06/MF A01
80-7191	6:16882	NTIS, PC A05/MF A01
80-8052	6:16680	NTIS, PC A06/MF A01
81-0013	6:17898	NTIS, PC A02/MF A01
81-0021	6:16743	NTIS, PC A06/MF A01
81-0063C	6:17125	NTIS, PC A03/MF A01
81-0067C	6:16877	NTIS, PC A02/MF A01
81-0116	6:17800	NTIS, PC A04/MF A01
81-0210	6:17445	NTIS, PC A03/MF A01
81-0371C	6:16510	NTIS, PC A03/MF A01
81-0380	6:16758	NTIS, PC A05/MF A01
81-0387C	6:16511	NTIS, PC A03/MF A01
81-0473	6:16874	NTIS, PC A03/MF A01
81-0475C	6:17144	NTIS, PC A02/MF A01
81-0570C	6:17077	NTIS, PC A02/MF A01
81-0806C	6:17131	NTIS, PC A02/MF A01
81-0968C	6:16389	NTIS, PC A03/MF A01
81-6001	6:16528	NTIS, PC A02/MF A01
81-7002	6:16656	NTIS, PC A05/MF A01
81-7005	6:16657	NTIS, PC A05/MF A01
81-7069	6:16590	NTIS, PC A06/MF A01
81-8665	6:16719	NTIS, PC A03/MF A01
SERI/CP-		
622-1086	6:16658	NTIS, PC A11/MF A01
622-1086	6:16659	NTIS, PC A11/MF A01
SERI/PR-		
8143-1-T3	6:16660	NTIS, PC A05/MF A01
SERI/SP-		
433-487	6:16675	NTIS, PC A02/MF A01
SERI/TP-		
631-1159	6:16703	NTIS, PC A02/MF A01

Report No.	*Abstract No.*	*Availability*
632-1123	6:16704	NTIS, PC A02/MF A01
633-1148	6:16681	NTIS, PC A02/MF A01
721-1133	6:16978	NTIS, PC A02/MF A01
731-1128	6:16633	NTIS, PC A02/MF A01
SERI/TR-		
631-1004	6:16661	NTIS, PC A02/MF A01
633-1063	6:16630	NTIS, PC A02/MF A01
721-822	6:16705	NTIS, PC A04/MF A01
731-905	6:16706	NTIS, PC A02/MF A01
751-751	6:16707	NTIS, PC A11/MF A01
751-752	6:16687	NTIS, PC A06/MF A01
751-753	6:16628	NTIS, PC A11/MF A01
751-793	6:16726	NTIS, PC A10/MF A01
8272-1-T1	6:16662	NTIS, PC A09/MF A01
SETEC-CE-		
81-001	6:16402	*See* DOE/ET/04502-7
SLAC-		
234	6:17899	NTIS, PC A07/MF A01
239	6:17300	NTIS, PC A99/MF A01
239	6:17301	NTIS, PC A99/MF A01
239	6:17302	NTIS, PC A99/MF A01
239	6:17303	NTIS, PC A99/MF A01
239	6:17304	NTIS, PC A99/MF A01
239	6:17316	NTIS, PC A99/MF A01
239	6:17317	NTIS, PC A99/MF A01
239	6:17318	NTIS, PC A99/MF A01
239	6:17319	NTIS, PC A99/MF A01
239	6:17320	NTIS, PC A99/MF A01
239	6:17562	NTIS, PC A99/MF A01
239	6:17632	NTIS, PC A99/MF A01
239	6:17633	NTIS, PC A99/MF A01
239	6:17634	NTIS, PC A99/MF A01
239	6:17635	NTIS, PC A99/MF A01
239	6:17636	NTIS, PC A99/MF A01
239	6:17637	NTIS, PC A99/MF A01
239	6:17638	NTIS, PC A99/MF A01
239	6:17639	NTIS, PC A99/MF A01
239	6:17640	NTIS, PC A99/MF A01
239	6:17641	NTIS, PC A99/MF A01
239	6:17658	NTIS, PC A99/MF A01
239	6:17659	NTIS, PC A99/MF A01
239	6:17660	NTIS, PC A99/MF A01
239	6:17661	NTIS, PC A99/MF A01
239	6:17672	NTIS, PC A99/MF A01
239	6:17741	NTIS, PC A99/MF A01
239	6:17742	NTIS, PC A99/MF A01
SLAC-PUB-		
2662	6:17745	NTIS, PC A02/MF A01
SOLAR/1008-		
80/ 50	6:16708	NTIS, PC A04/MF A01
TAC-H-		
80-004	6:16596	Univ. of New Mexico, Albuquerque
TIC-		
0156	6:16557	*See* SAND-80-2124
TR-		
80/ 031-001	6:16390	NTIS, PC A16/MF A01
80/ 031-001	6:16417	NTIS, PC A16/MF A01
80/ 031-001	6:16421	NTIS, PC A16/MF A01
80/ 031-001	6:16607	NTIS, PC A16/MF A01
80/ 031-001	6:16608	NTIS, PC A16/MF A01
80/ 031-001	6:16609	NTIS, PC A16/MF A01
80/ 031-001	6:16610	NTIS, PC A16/MF A01
80/ 031-001	6:16611	NTIS, PC A16/MF A01
80/ 031-001	6:16612	NTIS, PC A16/MF A01
80/ 031-001	6:16613	NTIS, PC A16/MF A01
80/ 031-001	6:17449	NTIS, PC A16/MF A01
80/ 031-001	6:17906	NTIS, PC A16/MF A01
TRW-		
33876-7	6:17830	*See* DOE/DP/40109-2
TTC-		
0151	6:16556	*See* SAND-80-2012
UCID-		
18282(Rev.1)	6:16526	NTIS, PC A03/MF A01
18585(Suppl.1)	6:16515	NTIS, PC A02/MF A01
18750	6:17212	NTIS, PC A03/MF A01
18798	6:17882	NTIS, PC A03/MF A01
18845	6:16571	NTIS, PC A03/MF A01
18890	6:16906	NTIS, PC A03/MF A01
18916	6:17883	NTIS, PC A03/MF A01
18948	6:17884	NTIS, PC A02/MF A01
18977	6:16682	NTIS, PC A02/MF A01
18981	6:17900	NTIS, PC A04/MF A01
18988	6:17801	NTIS, PC A02/MF A01
18989	6:17885	NTIS, PC A03/MF A01
18991	6:16955	NTIS, PC A02/MF A01
18997	6:17378	NTIS, PC A02/MF A01
18997	6:17378	NTIS, PC A02/MF A01
UCLA-		
12-1281	6:16634	NTIS, PC A02/MF A01
12/ 1282	6:16635	NTIS, PC A09/MF A01
12/ 1283	6:16636	NTIS, PC A06/MF A01
UCR-		
34P107-263	6:17642	NTIS, PC A03/MF A01
UCRL-		
13897(Rev.1)	6:16745	NTIS, PC A04/MF A01
15318	6:17116	NTIS, PC A03/MF A01
15323	6:16527	NTIS, PC A16/MF A01
15324	6:16879	NTIS, PC A03/MF A01
15329	6:16720	NTIS, PC A03/MF A01
15332	6:17109	NTIS, PC A02/MF A01
50025-80-3	6:17238	NTIS, PC A02/MF A01
53066	6:17422	NTIS, PC A05/MF A01
53105	6:17132	NTIS, PC A02/MF A01
53116	6:17213	NTIS, PC A02/MF A01
83789(Rev.1)	6:17554	NTIS, PC A02/MF A01
84039	6:17133	NTIS, PC A02/MF A01
84260	6:17221	NTIS, PC A03/MF A01
84445	6:17071	NTIS, PC A05/MF A01
84549	6:17886	NTIS, PC A02/MF A01
84672	6:17345	NTIS, PC A02/MF A01
84843	6:17078	NTIS, PC A02/MF A01
85032	6:16572	NTIS, PC A03/MF A01
85037	6:17282	NTIS, PC A02/MF A01
85060	6:17283	NTIS, PC A02/MF A01
85073	6:17887	NTIS, PC A02/MF A01
85390	6:17072	NTIS, PC A03/MF A01
85425	6:17073	NTIS, PC A02/MF A01
85666	6:17802	NTIS, PC A03/MF A01
85677-VUGRAPH	6:17625	NTIS, PC A03/MF A01
85679	6:17901	NTIS, PC A04/MF A01
85680(VUGRAPH)	6:17902	NTIS, PC A02/MF A01
UCRL-Trans-		
11661	6:17340	NTIS, PC A04/MF A01
UILU-ENG-		
80-1743	6:17895	*See* DOE/ER/02383-T1
80-1747	6:17896	*See* DOE/ER/02383-T2
81-1703	6:17894	*See* DOE/ER/02383-0078
UIUCDCS-R-		
80-1012	6:17896	*See* DOE/ER/02383-T2
80-1045	6:17895	*See* DOE/ER/02383-T1
81-1054	6:17894	*See* DOE/ER/02383-0078
UR-		
3490-1883	6:17535	NTIS, PC A10/MF A01
3490-1977	6:17503	NTIS, PC A02/MF A01
3490-1978	6:16577	NTIS, PC A02/MF A01
3490-1979	6:17346	NTIS, PC A03/MF A01
3490-1981	6:17513	NTIS, PC A08/MF A01
UTRC-R-		
79-953050-1	6:16696	*See* DOE/CS/34510-T1
Y-		
2234	6:17214	NTIS, PC A05/MF A01
2235	6:17215	NTIS, PC A02/MF A01
Y/DK-		
263	6:16399	NTIS, PC A02/MF A01

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A17.....27.50	E17.....42.50	T17.....1,080.00
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